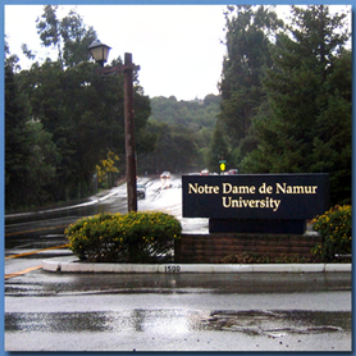
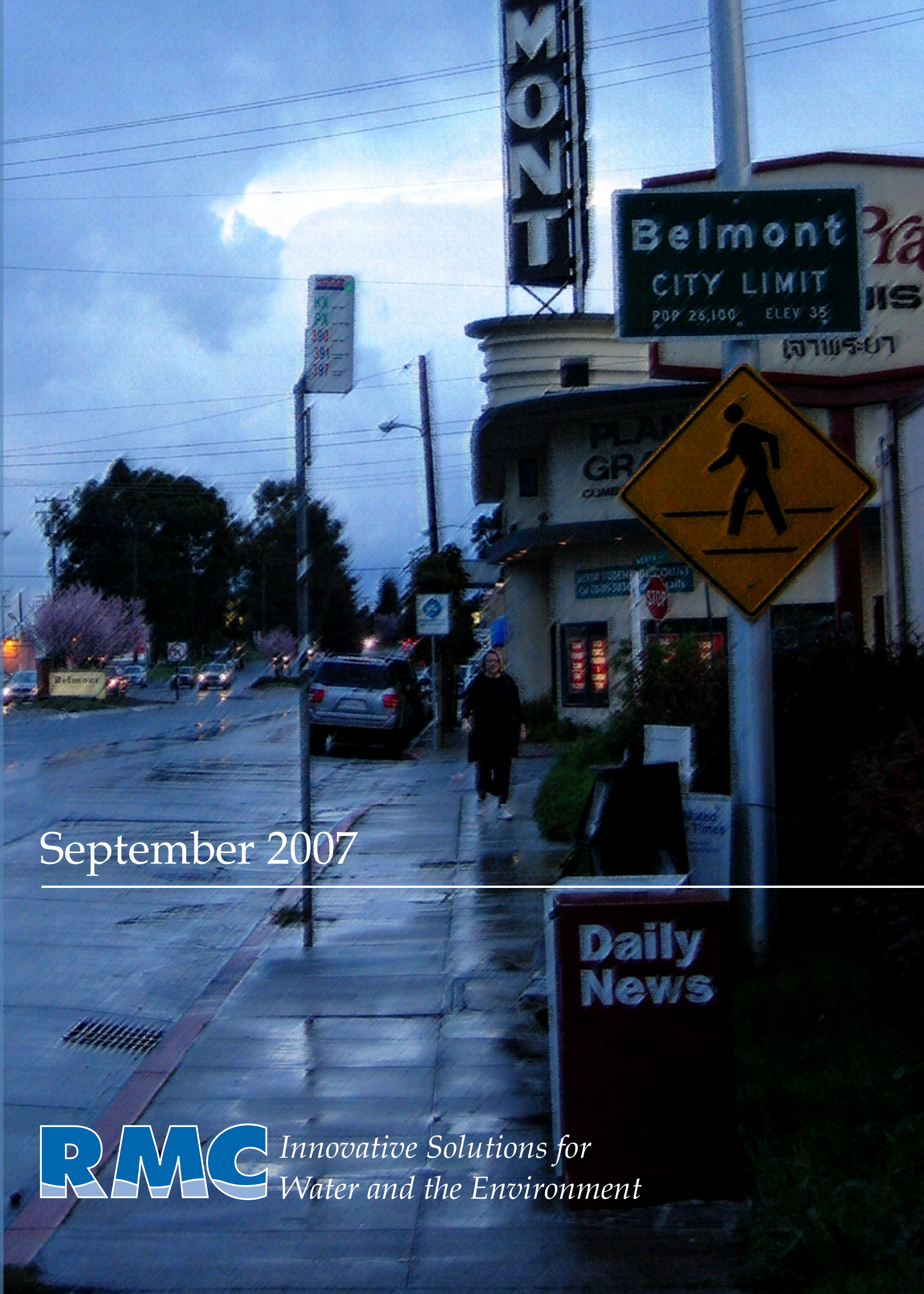
City of Belmont

Sanitary Sewer Rehabilitation Master Plan

Final Report





September 2007

RMC *Innovative Solutions for Water and the Environment*

CALIFORNIA
CITY OF BELMONT

Sanitary Sewer Rehabilitation Master Plan Final Report

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RMC
Water and Environment

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STATE OF CALIFORNIA

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Abbreviations and Definitions

ACP	Asbestos cement pipe
CCTV	Closed-circuit television
CIP	Capital Improvement Program; cast iron pipe
CIPP	Cured-in-place pipe
City	City of Belmont
DIP	Ductile iron pipe
DWF	Dry weather flow: the flow during non-rainfall periods, composed of normal sanitary flow contributions from residential, commercial, institutional, and industrial users of a sewer system plus any dry season groundwater infiltration.
E2	E2 Consulting Engineers, Inc.
ENR-CCI	Engineering News Record Construction Cost Index: an index published monthly by Engineering News Record magazine and used to reference construction costs (such as those for wastewater system facilities) to a specific date and location.
GIS	Geographic Information System: a computerized system in which geographical features (e.g., sewer facilities, parcels, land use) are linked to an attribute database to facilitate analysis and presentation of information.
gpad	Gallons per day per acre
gpd	Gallons per day
Gpm	Gallons per minute
GWI	Groundwater infiltration: extraneous water that infiltrates a sewer system from the ground through defective pipes and manholes. Groundwater is considered to be a relatively constant daily flow that varies seasonally and depends on location of sewers with respect to the groundwater table.
HDPE	High density polyethylene (pipe)
hp	Horsepower
I/I	Infiltration/inflow: extraneous groundwater and/or storm water that enter a sanitary sewer system.
lf	Linear feet
MGD	Million gallons per day
PS	Pump Station
PVC	Polyvinyl chloride (pipe)
PWWF	Peak wet weather flow: the peak flow during a given storm event from dry weather flow plus infiltration and inflow.

Abbreviations and Definitions (cont.)

RDI/I	Rainfall-dependent infiltration/inflow: the infiltration and inflow into a sewer system directly related to a rainfall event. RDI/I may cause rapid, short-term peak flows in the sewer system that recede after the rainfall has ended.
Regional Board	Regional Water Quality Control Board: a division of the State Water Resources Control Board that administers NPDES permits in a specific region of California. The City of Belmont falls under the jurisdiction of the San Francisco Bay Regional Board.
RMC	RMC Water and Environment
SBSA	South Bayside System Authority
SSMP	Sewer System Management Plan
State Board	State Water Resources Control Board
Surcharge	The hydraulic condition in a sewer pipeline in which the elevation of the hydraulic gradeline (water level) is above the crown (top) of the pipe. Under such a condition, the water in the pipe rises into the manholes and could overflow onto the ground if the hydraulic gradeline exceeds the elevation of the manhole rims.
VCP	Vitrified clay pipe

Executive Summary

The City of Belmont Sanitary Sewer Rehabilitation Plan defines and presents the near-term and long-term rehabilitation needs of the City's wastewater collection system and estimates the capital budget requirements for meeting those needs as part of the City's 5-year and 25-year Capital Improvement Programs. The information presented in the Rehabilitation Plan will also be incorporated by the City into its Sewer System Management Plan (SSMP), which must be prepared to satisfy requirements of the San Francisco Bay Regional Water Quality Control Board (Regional Board) and the Statewide General Wastewater Discharge Requirements issued by the State Water Resources Control Board (State Board).

This Rehabilitation Plan follows several other studies that the City has completed over the past 20 years to help assess and improve the condition of its sewer system and provide effective sewer service to City residents and businesses. City staff are also actively involved in several professional groups, which helps them stay up to date on industry practices and various State and Regional regulations for sanitary sewer systems.

Existing Sewer System and Rehabilitation Activities

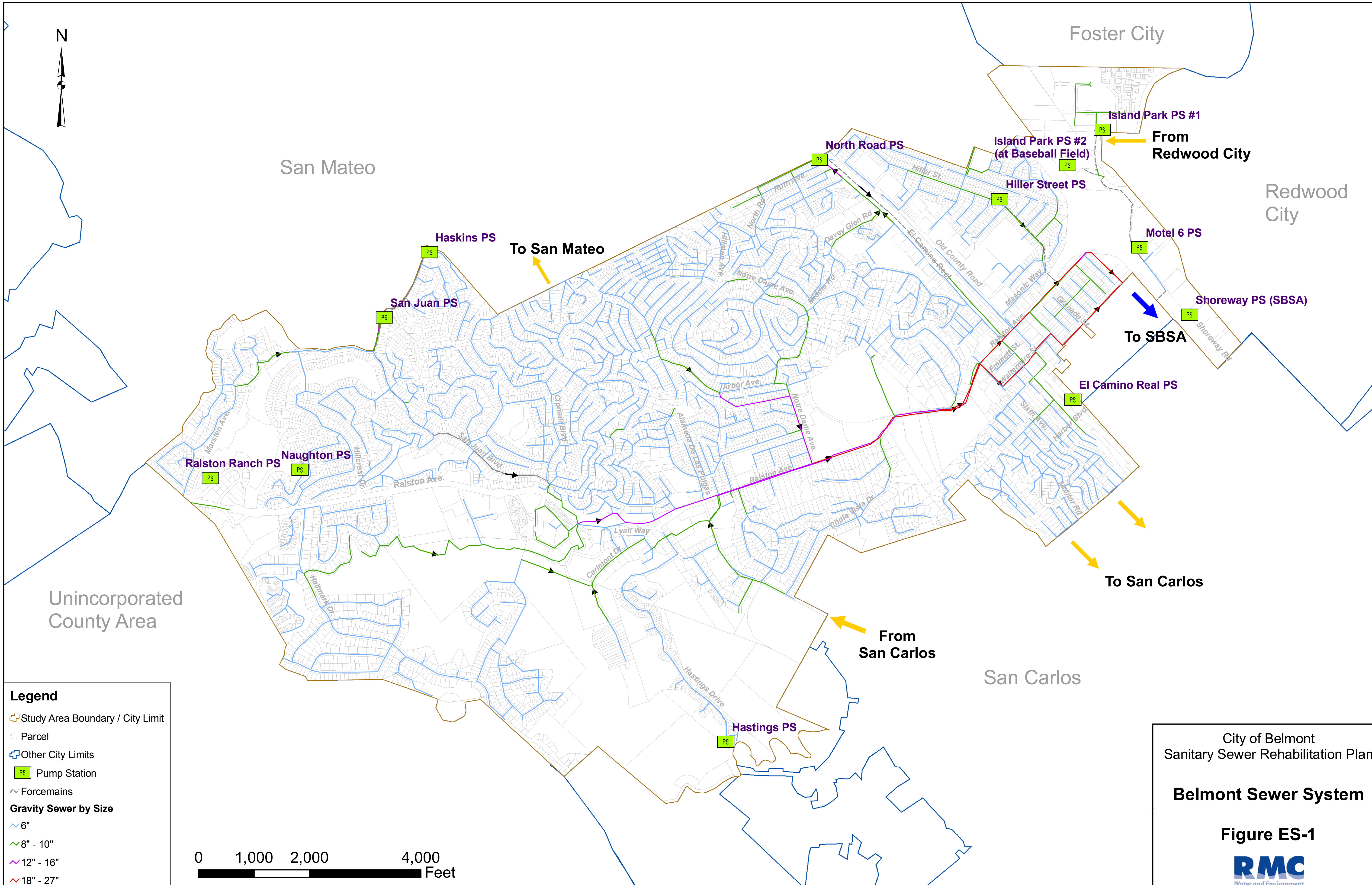
The City's sewer system, shown in Figure ES-1, consists of approximately 82 miles of gravity sewer pipelines, ranging in size from 6 inches to 27 inches in diameter, plus 11 pump stations and over 3 miles of associated force mains. Wastewater generated in the City is transported to the South Bayside System Authority (SBSA) sub-regional Wastewater Treatment Plant for treatment and disposal.

Since the early 1990s, the City has had an on-going inspection and rehabilitation program for its wastewater collection system and has rehabilitated, on average, approximately 8,000 feet of gravity sewer pipe per year, or about 2 percent of the system annually. Therefore, nearly 25 miles of sewers, or approximately 30 percent of the gravity sewer system, have already undergone rehabilitation or replacement since 1991. This is an excellent rate of rehabilitation that will help the City extend the service life of its sewer system pipes and maintain the structural integrity of the system. The City has also done work since the early 1990s to assess the condition and rehabilitation needs of its sewage pump stations and associated force mains.

Gravity Sewer Rehabilitation Needs Analysis

Material service life was the primary criterion used to quantify anticipated rehabilitation needs for the City's gravity sewers during the planning period. Although some pipes may deteriorate faster or slower than expected due to site-specific sewer conditions, an analysis of pipe age and material service life provides a good basis for anticipating the extent of rehabilitation needs in each area of the system and budgeting for those needs on a planning level.

The gravity sewer rehabilitation plan focuses on vitrified clay pipe (VCP) sewers constructed prior to about 1960 that are now nearly 50 years old or older. Because pipe joint materials used for VCP sewers during this time are prone to failure and leakage, these sewers are generally thought to have a useful service life of approximately 50 to 75 years. These sewers have therefore either already reached the end of their service life, or will do so during the 25-year planning period of this study. Plastic pipe, which came into common use in the City in the 1990s, and newer VCP sewers are generally considered to have a longer service life and would outlast the planning period of this study. The City's sewer asset data, which was inventoried as part of this study, show that nearly 40 percent of the City's gravity sewers are now about 50 years old or older, and nearly 20 percent are now about 80 years old or older. Figure ES-2 shows the age distribution of the City's gravity sewers.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Belmont Sewer System

Figure ES-1

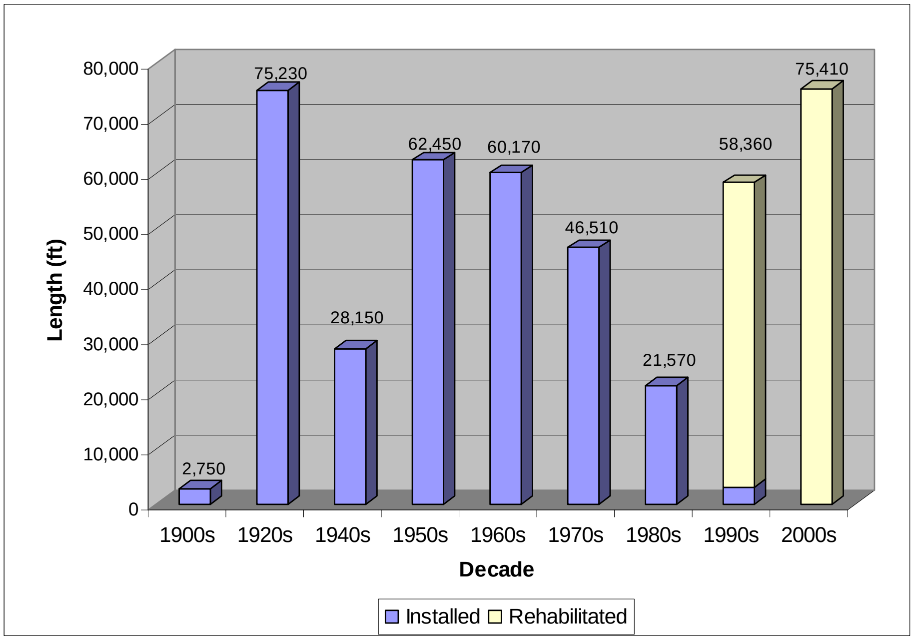


Figure ES-2 Gravity Sewer Age Distribution

Rehabilitation Capital Improvement Program

In 2006, the City sold $7 million of bonds to fund the sewer rehabilitation program over a 5-year period. The purpose of this study is to estimate the sewer rehabilitation needs beyond the 5-year program, and to refine the basis for prioritizing areas for rehabilitation based on the latest available information in the City's asset inventory and from flow monitoring conducted in the system for this study. Although the focus of this study is on the gravity sewer system, this Sanitary Sewer Rehabilitation Plan also addresses the pump stations and force mains in the system based on specific information provided by City staff and general recommendations with respect to anticipated future needs for facility evaluations and repairs.

The Rehabilitation Plan covers both near-term needs (specific pipe and pump station rehabilitation needs that the City has identified to be completed within the next 10 years), as well as longer-term needs over the next 25 years. The near-term and long-term needs together comprise the 25-year Rehabilitation Capital Improvement Program (CIP). Based on this CIP, the average rehabilitation rate of gravity sewers over the next 25 years would be approximately 8,300 feet per year, which is consistent with the City's historical rehabilitation rate.

Table ES-1 summarizes the total estimated costs for the City's 25-year Rehabilitation CIP. The facilities addressed in the CIP are shown in Figure ES-3. Costs are presented both with and without lower lateral replacement (lower lateral replacement is recommended for addressing wet weather infiltration/inflow in the sewer system, as discussed later in this Executive Summary). The total estimated cost of the 25-year CIP averages approximately $1.6 million annually without lower lateral replacement, or $1.8 million annually with lower lateral replacement. Table ES-2 summarizes the annual breakdown for the first 5 years of the CIP. This level of funding would allow for completion of over half of the City's near-term gravity sewer rehabilitation plan within 5 years.

Table ES-1 Estimated Costs for 25-year Rehabilitation CIP

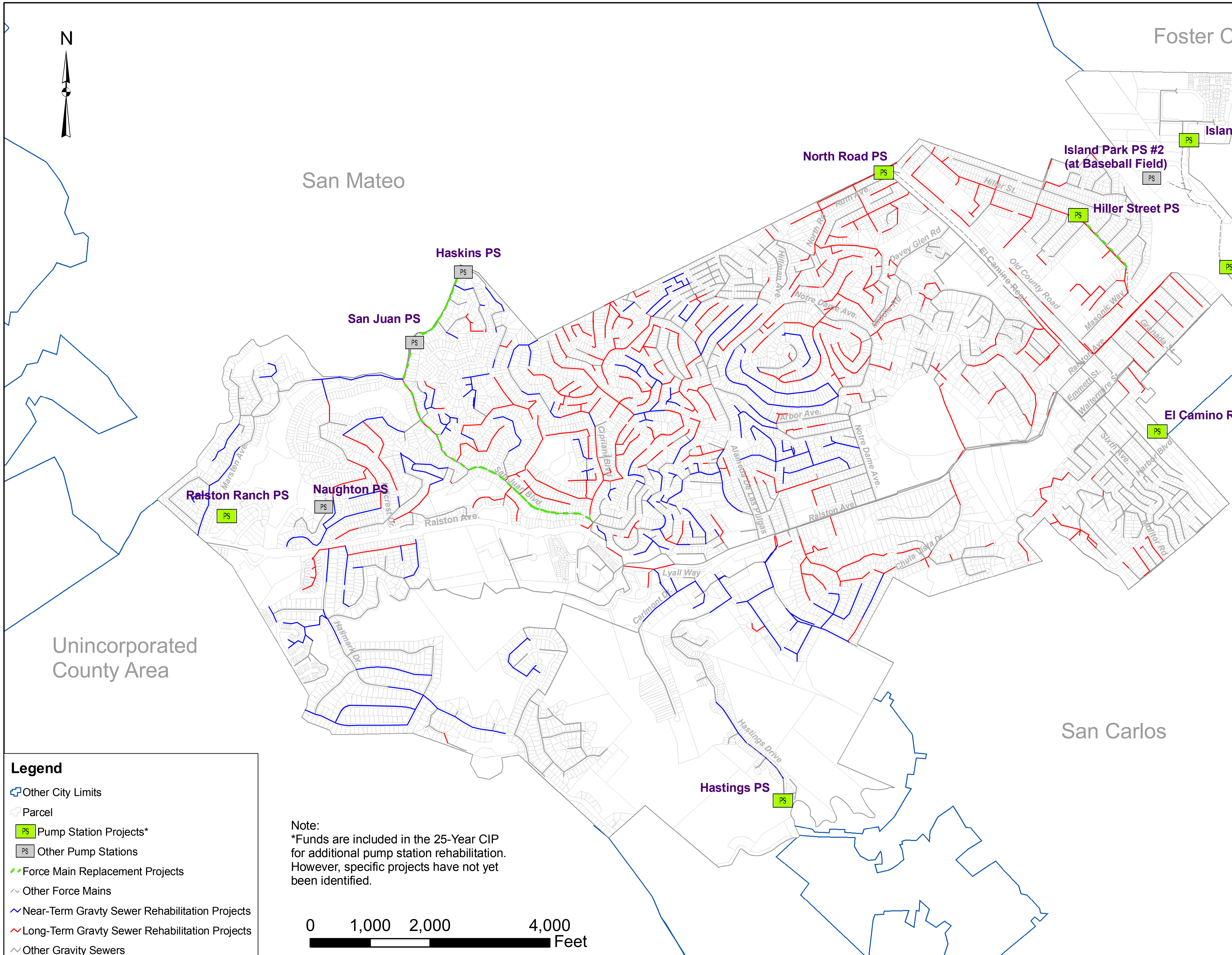
Rehabilitation Item	Total
Gravity Sewer Rehabilitation	$ 32,100,000
Capacity Study[a]	$ 150,000
Pump Stations	
Hastings Rehabilitation[b]	$ 500,000
Hiller & North Road Emergency Generators[b]	$ 150,000
Island Park & Motel Evaluation and Upgrades[b]	$ 250,000
Hiller & North Road Control Panel Canopy[b]	$ 150,000
El Camino & Ralston Ranch Upgrades[b]	$ 500,000
Allowance for Future PS Rehabilitation	$ 2,000,000
Force Mains	
Allowance for Force Main Evaluation	$ 600,000
Allowance for Force Main Spot Repair	$ 240,000
Allowance for Force Main Replacement[c]	$ 2,500,000
Total Estimated Cost	**$ 39,100,000**
Additional Cost for Lower Lateral Replacement in Conjunction with Gravity Sewer Rehabilitation	*$ 5,100,000*
Total Estimated Cost, incl. Lower Lateral Replacement[d]	***$ 44,200,000***

a. Recommended for compliance with SSMP requirements.
b. Estimated costs provided by City
c. Budget for replacement of San Juan; Hastings; and 1,300 feet of Hiller force mains
d. Lower lateral replacement in conjunction with main line sewer rehabilitation is recommended to help reduce I/I, as described below.

Table ES-2 Estimated Cost by Year for 5-year Rehabilitation CIP

Cost Item	FY 2007/2008	FY 2008/2009	FY 2009/2010	FY 2010/2011	FY 2011/2012	Total
Gravity Sewer Rehabilitation	$ 800,000	$1,500,000	$1,300,000	$1,400,000	$1,400,000	$6,400,000
Hastings PS Rehabilitation[a]	$ 500,000	-	-	-	-	$ 500,000
Hiller and North Road PS Emergency Generators[a]	$ 150,000	-	-	-	-	$ 150,000
Island Park and Motel PS Evaluation & Improvements[a]	-	$ 50,000	$ 200,000	-	-	$ 250,000
Other PS Evaluations & Improvements[a]	-	-	-	$ 200,000	$ 200,000	$ 400,000
Force Main Evaluations[b]	-	$ 50,000	$ 50,000	$ 25,000	$ 25,000	$ 150,000
Force Main Annual Spot Repair Allowance	-	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 40,000
Capacity Study	$ 150,000	-	-	-	-	$ 150,000
Total	**$1,600,000**	**$1,610,000**	**$1,560,000**	**$1,635,000**	**$1,635,000**	**$8,040,000**
Additional Cost for Lower Lateral Replacement in Conjunction with Gravity Sewer Rehabilitation	$ 160,000	$ 300,000	$ 260,000	$ 280,000	$ 280,000	$1,300,000
Total incl. Lower Lateral Replacement[c]	***$1,760,000***	***$1,910,000***	***$1,820,000***	***$1,915,000***	***$1,915,000***	***$9,340,000***

a. Estimated costs provided by City.
b. Budgeted for Haskins, Island Park, and Naughton force main evaluations in 2008/2009, 2009/2010, and 2010/2011.
c. Lower lateral replacement in conjunction with main line sewer rehabilitation is recommended to help reduce I/I, as described below.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Sewer Rehabilitation Capital Improvement Plan

Figure ES-3

RMC Water and Environment

The methodology used to develop the above rehabilitation CIP provides a good foundation for estimating the extent of anticipated rehabilitation needs; however, the City must consider actual condition assessment data collected through its on-going CCTV inspection program and should let those results be the basis for determining specific pipes to rehabilitate or replace.

In addition to the CIP requirements for rehabilitation of the City's sanitary sewer system presented in this report, the City will also need to participate in funding improvements to SBSA facilities, such as upgrade of the Shoreway Pump Station. Based on information provided by the City, the estimated cost of Belmont's share of these improvements is about $10 million.

Recommendations for Addressing Infiltration/Inflow

A flow monitoring program was conducted as part of this study from late December 2005 to early March 2006 to identify areas of the City with relatively high infiltration/inflow (I/I). I/I is extraneous water that enters the sewer system through illegal connections and/or defects in sewer pipes, manholes, and service laterals. The program looked at both groundwater infiltration (GWI) and rainfall-dependent I/I (RDI/I). GWI enters the sewer system from underground through cracks and defects in pipes and manholes. This type of infiltration varies depending on the location and condition of the sewers, type of soil and relative location of the groundwater table, and is typically greater in late winter and spring following the rainy season when groundwater levels are higher. RDI/I occurs during and immediately following rainfall events and results from either direct inflow of rain water (e.g., illegal connections of roof leaders, yard or driveway drains, or other types of direct drainage connections, or street runoff entering through manhole covers) or from infiltration through temporarily wet soils and into defects in laterals, mains, and manholes.

The GWI analysis indicates that there is no evidence of temporarily elevated GWI during the wet weather season in the majority of system. However, the RDI/I analysis indicates that RDI/I is a significant component of peak wet weather flows in the City's system. The high RDI/I found in the City's system is typical of many older communities in the San Francisco Bay Area, and other studies have shown that a large portion of the RDI/I originates from sewer laterals. Although the City has conducted a significant amount of sewer rehabilitation, RDI/I remains high. This could be attributed to the fact that laterals have not been rehabilitated along with the mains. Furthermore, a large portion of the sewer rehabilitation work completed by the City has been by lining of sewer mains with internal reconnections of the laterals, which may leave a gap between the lined main line and the lateral. The connections of the laterals to the sewer mains are believed to be a significant source of I/I in many older sewer systems. Therefore, the internal reconnections used in lining, while avoiding the need to excavate each lateral and thereby minimizing cost and disruption to city streets and neighborhoods, may fail to address a key point of entry of I/I into the system.

To address the RDI/I problem, it is recommended that the City consider one or more of the following approaches:

- Implement external lateral reconnections or reconstruction, or a more effective method of sealing the lateral connection, for all sewer main rehabilitation.
- Rehabilitate or replace the lower portion of the service laterals whenever the sewer main is rehabilitated or replaced. A number of Bay Area cities and agencies are taking this approach for their sewer rehabilitation programs.
- Require property owners to test/inspect their sewer laterals whenever a public sewer main project is scheduled on their street, and repair or replace the lateral if it fails the test. The City could also

ease the burden on these property owners, financial and otherwise, by arranging to contract for the lateral work through the sewer main construction contractor.

- Explore the possibility of implementing a private lateral compliance program that requires testing/inspection and rehabilitation, if necessary, of the lateral at sale or transfer of the property, and/or at other trigger points such as major remodels, changes in property use, whenever a sewer blockage occurs, or at designated intervals of time based on the age of the lateral. Such programs have been adopted by a number of Bay Area communities.

Based on the estimated rehabilitation costs, the estimated additional cost for including the lower laterals in public sewer rehabilitation projects would be approximately 20 percent more than the City's current rehabilitation approach, depending on rehabilitation method used, but would likely provide benefits in terms of reduced I/I and service calls. Although the resulting amount of I/I reduction cannot be accurately predicted, the experience of other agencies that have implemented I/I rehabilitation programs indicates that reductions in I/I of around 30 percent could be possible by including lower laterals in the City's rehabilitation program.

Additional Recommendations

The City has certified to the Regional Board that they have completed the first four elements of their SSMP. This Rehabilitation Plan will help the City meet some of its additional goals in preparing the SSMP, as this Plan complies with elements of the Regional Board and Statewide SSMP guidelines that require that each collection system agency develop short- and long-term rehabilitation plans for correction of deficiencies in the sewer system. However, this plan does not address all of the necessary items required under the SSMP, including a capacity assessment of the system. The flow monitoring work conducted for the I/I analysis revealed that several areas of the system may not have adequate capacity to convey peak wet weather flows during large storm events. It is recommended that the City take the next step in evaluating its system by conducting a capacity assessment of its trunk sewer network utilizing a hydraulic model to identify areas with potential capacity deficiencies and needed capacity improvements. If necessary, the sewer system CIP should then be updated to include these capacity improvements.

Chapter 1 Introduction

This report presents the recommended Sanitary Sewer Rehabilitation Plan for the City of Belmont (City). The Plan defines the near-term and long-term rehabilitation needs of the City's wastewater collection system and estimates the budget requirements for meeting those needs. The information presented in this Plan will also be incorporated by the City into its Sewer System Management Plan, which must be prepared to satisfy requirements of the San Francisco Bay Regional Water Quality Control Board (Regional Board) and the Statewide General Wastewater Discharge Requirements issued by the State Water Resources Control Board. This Plan primarily addresses the rehabilitation needs of wastewater collection system gravity pipelines; it does not address the capacity requirements of the system. The Plan also addresses the potential rehabilitation needs of the City's sewer pump stations and force mains, including rehabilitation projects already identified by the City, and budget allowances for future facility evaluations and rehabilitation. Specific evaluations of pump stations and force mains were not included in this study.

This introductory chapter provides background information on the scope and objectives of the Sanitary Sewer Rehabilitation Plan, an overview of the study area, and a description of the organization of this document.

1.1 Background and Purpose of Study

In 2005, the City retained RMC Water and Environment (RMC) to assist City staff in the preparation of the Sewer Rehabilitation Plan. RMC's team included one subconsultant, E2 Consulting Engineers, Inc. (E2) for flow monitoring. Prior studies completed concerning the City's sewer system include a Sanitary Sewer Master Plan (Wilsey & Ham, 1980); Infiltration/Inflow Study (CH2M Hill, 1991 and 1983); Infiltration/Inflow Source Detection Program (CH2M Hill, 1991); South Bayside System Authority Peak Wet Weather Flow Evaluation (Whitley, Burchett & Associates, 1996); Sanitary Sewer Pump Station Study (Brian Kangas Foulk, 1996); and a Sewer Rate Study (Hilton Farnkopf & Hobson, 1999-2000).

The main objective of this Rehabilitation Plan study is to quantify the long-term needs and estimated planning-level costs for the rehabilitation and replacement of the City's collection system infrastructure based on the City's asset data (length, diameter, age, material, and expected life of sewers). Rehabilitation needs are also prioritized based on analysis of flow monitoring data.

The City has been conducting closed-circuit television (CCTV) inspection and rehabilitation of its wastewater collection since 1991. Since 2004, the City has operated its own CCTV program; prior to that, CCTV inspection was done under contract. On the average, about 8,000 feet of pipe are rehabilitated or replaced each year. The CCTV and rehabilitation programs are prioritized based on historical maintenance problem areas, and conducted by area (sewer basins, as defined in an earlier sewer system evaluation study completed in 1990). The City has also done work to assess the condition and rehabilitation needs of its sewage pump stations and associated force mains. In 2006, the City sold $7 million of bonds to fund the sewer rehabilitation program over a 5-year period. The purpose of this study is to estimate the sewer rehabilitation needs beyond the 5-year program, and to refine the basis for prioritizing areas for rehabilitation based on the latest available information in the City's asset inventory and from flow monitoring conducted in the system for this study.

1.2 Study Area

The study area for this project consists of the City of Belmont, located in San Mateo County approximately 25 miles south of San Francisco. Figure 1-1 shows the City boundary and major roads, as well as neighboring cities. The City covers approximately 4.5 square miles, with a population of about 26,000 residents. The City is primarily residential with some commercial areas located along El Camino Real, Ralston Avenue, and near Highway 101, as well as some industrial areas along Old County Road.

The City is a member agency of the South Bayside System Authority (SBSA). Wastewater generated in the City is transported to the SBSA sub-regional Wastewater Treatment Plant for treatment and disposal.

1.3 Scope of Study

This study was based on asset data provided by the City and flow monitoring data collected as a part of this project. This study did not include inspection or assessment of the actual condition of the City's collection system. These activities are conducted under an on-going program by the City.

Additional study tasks included analysis of the cost of infiltration/inflow (I/I), based on historical flow records and SBSA's billing structure. The results of this task are summarized in a separate Technical Memorandum (TM) that is included in Appendix B of this report.

1.4 Document Organization

The contents of each of the chapters of this report are described below. This report focuses on the core rehabilitation plan and estimated costs, and prioritization of the rehabilitation plan based on historical maintenance problems and I/I analysis of the flow monitoring data.

Chapter 1 Introduction

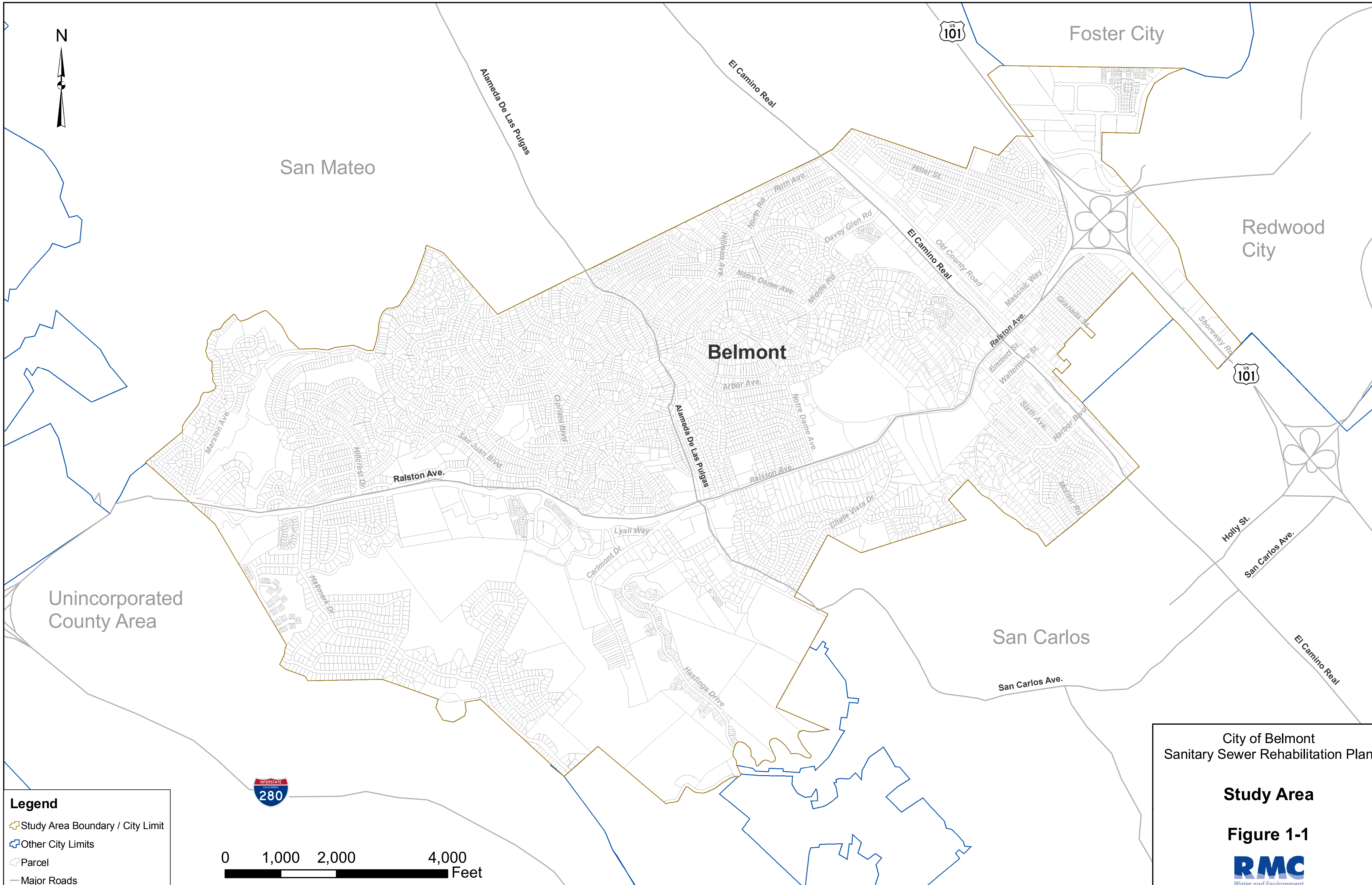
This introductory chapter provides background information on the scope and objectives of the City of Belmont Sanitary Sewer Rehabilitation Plan, an overview of the study area, and a description of the organization of this document.

Chapter 2 Wastewater Collection System

This chapter provides an overview of the City's wastewater collection system, including conveyance of wastewater within the City and discharge to the SBSA and neighboring cities. The sewer system assets are inventoried, including pipe length, diameter, age, and material, and maintenance of the system is discussed.

Chapter 3 Flow Monitoring and I/I Analysis

A flow monitoring program conducted in winter 2005/2006 provided the basis for assessing the relative magnitude of I/I in the Belmont sewer system and comparing areas of the City with respect to I/I contribution. This chapter discusses the flow monitoring program, and presents the analysis of the flow monitoring data. Recommendations for addressing I/I in the City's sewer system are also provided.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Study Area

Figure 1-1

Chapter 4 Gravity Sewer Rehabilitation Needs Assessment

The City's gravity sewer pipeline asset data were analyzed to identify anticipated sewer rehabilitation needs for the next 25 years, and to prioritize these needs based on pipe age, magnitude of observed RDI/I, and maintenance history. This Chapter discusses the results of this analysis. This information provides the basis for estimating the extent of anticipated rehabilitation needs in each basin. Rehabilitation methods commonly used by the City are also discussed.

Chapter 5 Rehabilitation Plan and CIP

This chapter presents the recommended Sanitary Sewer Rehabilitation Plan, including the estimated capital budgets needed for sewer system rehabilitation for the City's 5-year and 25-year Capital Improvement Programs. Although the focus of this study is on the gravity sewer system, the Rehabilitation Plan also addresses the pump stations and force mains in the system based on specific information provided by City staff and general recommendations with respect to anticipated future needs for facility evaluations and repairs.

Chapter 2 Wastewater Collection System

This chapter provides an overview of the City's wastewater collection system, including conveyance of wastewater within the City and discharge to the South Bayside System Authority (SBSA) and neighboring cities. The sewer system assets are inventoried, including pipe length, diameter, age, and material, and maintenance of the system is discussed.

2.1 System Overview

Figure 2-1 shows the City's sewer system. The City's sewer system consists of approximately 82 miles of gravity sewer pipelines, ranging in size from 6 inches to 27 inches in diameter, plus 11 pump stations and over 3 miles of associated force mains. Wastewater in most of the City's sewer system flows generally east to the SBSA Shoreway Pump Station on Shoreway Road. As indicated on Figure 2-1, there is a small area of the Belmont collection system on the north side of the City that discharges to the City of San Mateo collection system and a small area on the south side that discharges to the City of San Carlos collection system. There are also small areas in the Cities of San Carlos and Redwood City that discharge to the City's sewer system.

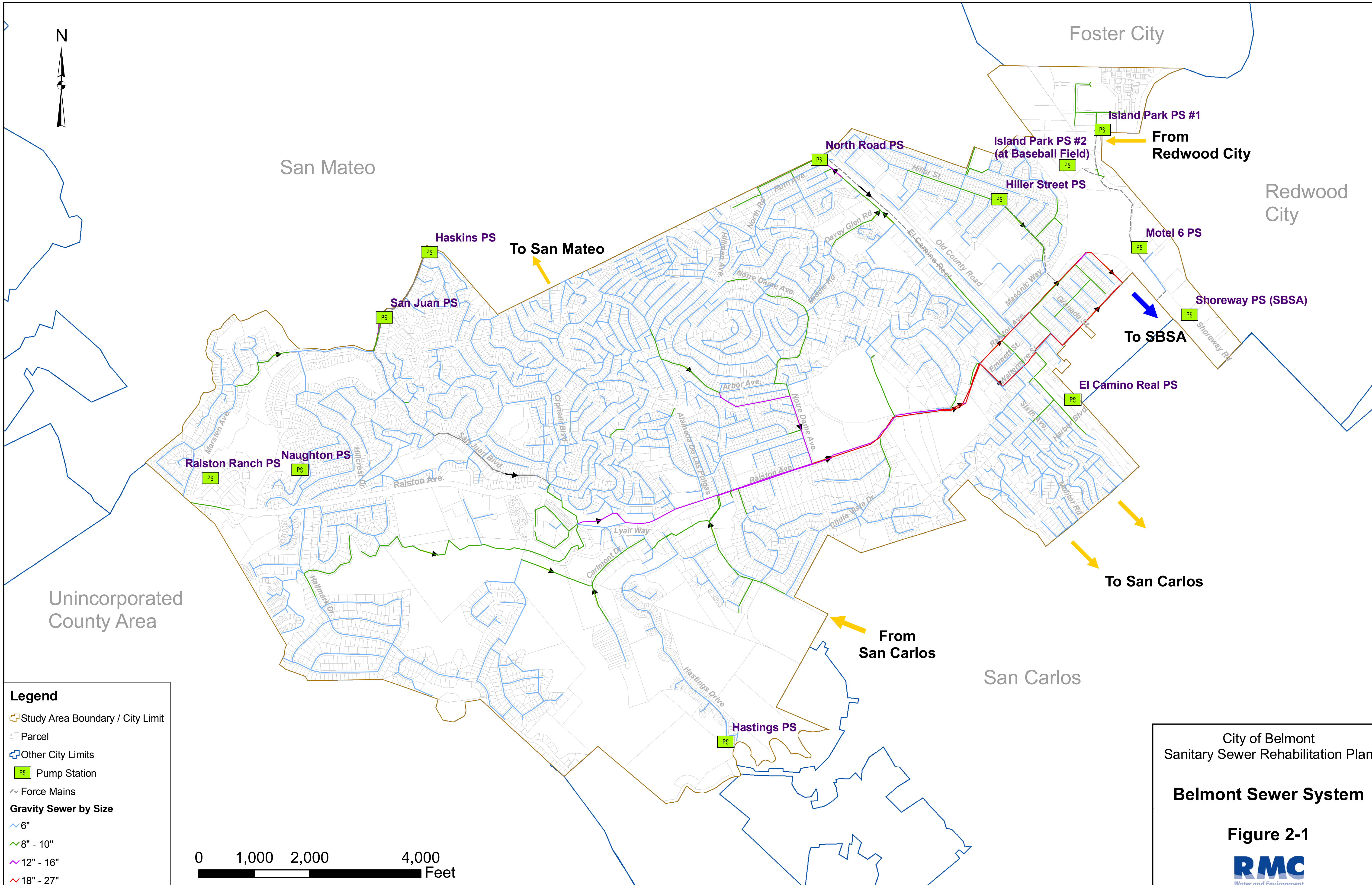
SBSA pumps Belmont's wastewater flow from the Shoreway Pump Station to the SBSA treatment plant in Redwood Shores. Wastewater flow is conveyed from the pump station through ½ mile of 24-inch diameter force main into SBSA's 43-inch diameter force main, which transports flow to the treatment plant. The Shoreway pump station has three 3,400-gpm, 100-hp pumps.

The City currently has 11.8 MGD peak wet weather flow and 2.74 MGD dry weather flow capacity rights with SBSA. The City purchased additional wet weather flow rights in year 2000 from their prior rights of 8.8 MGD peak wet weather flow. The City purchased additional dry weather flow rights in year 2001 from their prior rights of 2.3 MGD.

2.2 Sewer Basins

As part of an I/I study conducted in the 1980s (CH2M Hill, Infiltration/Inflow Evaluation, Draft Report, 1990), the City subdivided its service area into 15 basins that corresponded to areas isolated by flow meters during that study. These basins are shown in Figure 2-2. Since that study, the City has continued to use those basins for scheduling CCTV inspections, rehabilitation, and maintenance work.

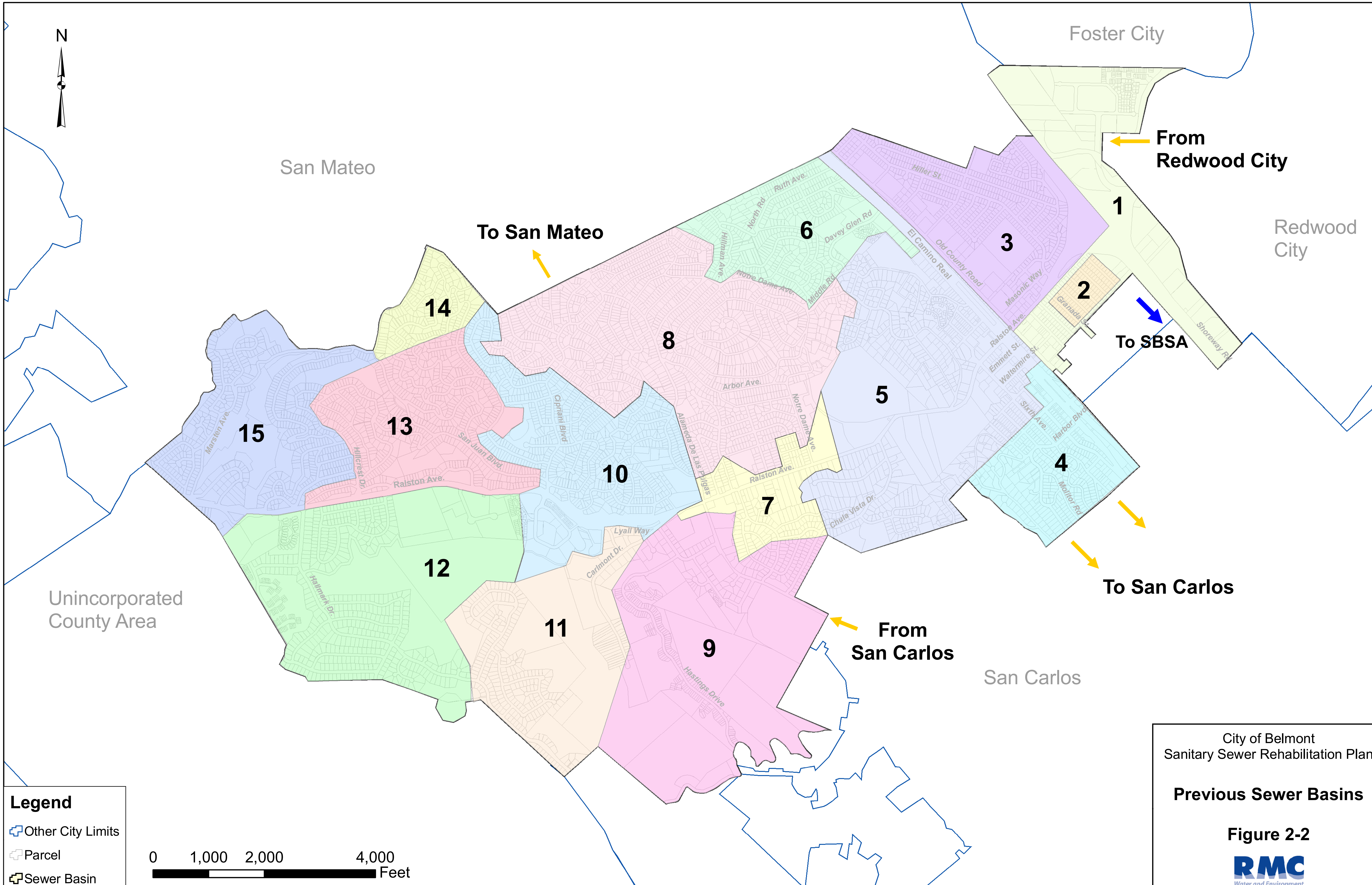
As discussed further in Chapter 3, these basins were refined as part of the current study to reflect more accurate mapping of the sewer system, as well as to correspond to flow meter locations selected for this study. Figure 2-3 shows the updated sewer basin boundaries. Most of the new basins are very similar in size and shape to the previous basins, although certain basins were subdivided to reflect the additional flow meters installed for this current study.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Belmont Sewer System

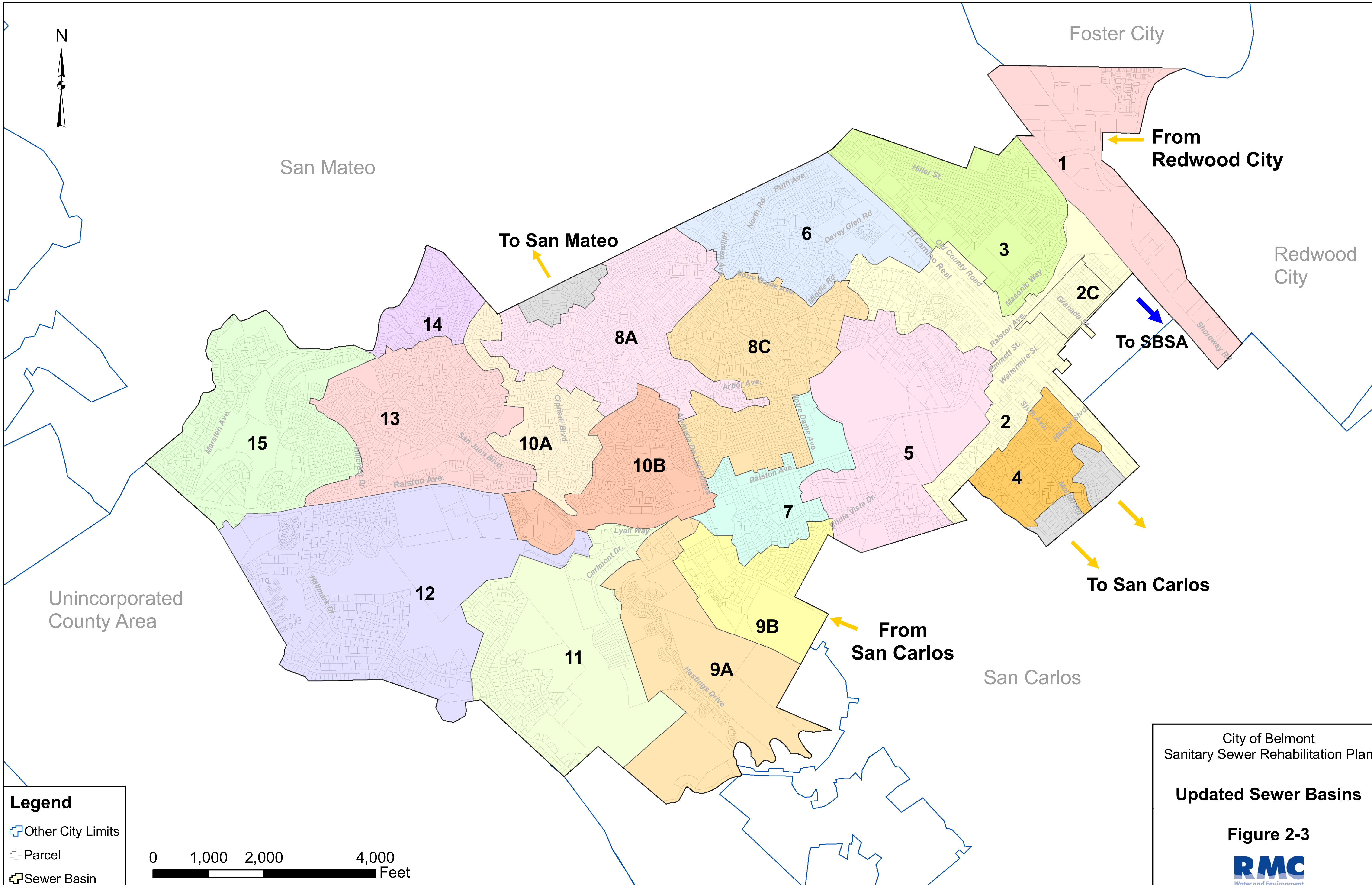
Figure 2-1



City of Belmont
Sanitary Sewer Rehabilitation Plan

Previous Sewer Basins

Figure 2-2



City of Belmont
Sanitary Sewer Rehabilitation Plan

Updated Sewer Basins

Figure 2-3

RMC Water and Environment

2.3 Gravity Sewer System Inventory

This section provides an inventory of certain gravity sewer system attributes, including pipe length, diameter, material, and age for the overall sewer collection system, as well as for each basin. The inventory was obtained from data stored by the City in its Geographic Information System (GIS) database. This inventory is used in later sections of this Plan to identify areas of the system that may be close to or beyond the end of their expected service life and therefore in need of rehabilitation, and also to determine the potential cost of rehabilitating sewer pipes in each basin.

Table 2-1 presents a breakdown of the length of gravity sewer pipelines in the City's collection system by diameter and basin. As noted in the table, about 90 percent of the sewers are 8 inches in diameter or smaller, and most of these are 6-inch diameter. The larger diameter lines primarily serve as "trunk sewers" to convey the collected wastewater flow to the SBSA system.

Table 2-1 Distribution of Gravity Sewer Length[a] (ft) by Pipe Diameter

Basin	6-in	8-in	10-in	12-in	15-in	18-in	21-in	27-in	Unk.[d]	Total	Perc.[e]
1	880	2,360	320	-	-	-	-	-	-	3,560	**0.8%**
2	25,150	2,710	910	60	-	2,530	3,400	780	-	35,550	**8.3%**
2C	3,010	2,880	-	240	-	-	-	-	-	6,120	**1.4%**
3	20,980	3,420	1,420	-	-	-	-	-	770	26,580	**6.2%**
4	17,020	1,260	410	-	-	-	-	-	-	18,690	**4.3%**
5	15,030[b]	2,710	-	50	1,890	4,200	760	-	-	24,630	**5.7%**
6	25,070	4,590	-	580	-	-	-	-	1,300	31,530	**7.3%**
7	5,910	620	1,540	1,870	2,140	730	-	-	-	12,800	**3.0%**
8A	44,890	1,260	560	1,020	-	-	-	-	-	47,730	**11.1%**
8C	34,200	3,520	-	1,790	220	-	-	-	-	39,730	**9.2%**
9A	8,540	340	850	-	-	-	-	-	-	9,720	**2.3%**
9B	6,860	1,260	1,120	-	-	-	-	-	-	9,240	**2.1%**
10A	18,150	880	-	-	-	-	-	-	-	19,030	**4.4%**
10B	20,870	2,850	110	2,460	260[c]	-	-	-	-	26,550	**6.2%**
11	13,030	3,370	-	-	-	-	-	-	1,670	18,080	**4.2%**
12	27,200	460	6,640	-	-	-	-	-	-	34,300	**8.0%**
13	27,800	90	-	-	-	-	-	-	-	27,880	**6.5%**
14	6,060	630	-	640	-	-	-	-	-	7,330	**1.7%**
15	17,770	2,200	-	-	-	-	-	-	-	19,970	**4.6%**
San Carlos	7,020	-	-	-	-	-	-	-	-	7,020	**1.6%**
San Mateo	4,570	-	-	-	-	-	-	-	-	4,570	**1.1%**
Total	**350,010**	**37,410**	**13,880**	**8,710**	**4,510**	**7,460**	**4,160**	**780**	**3,740**	**430,620**	**100.0%**
Perc.	**81.3%**	**8.7%**	**3.2%**	**2.0%**	**1.0%**	**1.7%**	**1.0%**	**0.2%**	**0.9%**		

a. Pipe lengths rounded to nearest 10 feet
b. Includes 340 feet 4-inch pipe
c. 16-inch pipe
d. Unknown pipe diameter
e. Percent of total system

Table 2-2 presents the average age of gravity sewers and the extent of rehabilitation in each basin. Figure 2-4 presents the length of sewer constructed or rehabilitated by decade, and Figure 2-5 shows a map of the sewers depicting the decade of construction or rehabilitation. The age of sewers ranges from new to about 100 years old, with an average age of about 40 years. Note that nearly 25 miles of sewers, or approximately 30 percent of the gravity sewer system, have already undergone rehabilitation or replacement since 1991. Figure 2-6 shows the sewers that have been rehabilitated or replaced. Historically, the City has replaced or rehabilitated over 8,000 feet of gravity sewers each year on average. The length of sewer rehabilitated or replaced in a year since the City began its rehabilitation program has ranged from 0 to over 28,000 feet. The age of these rehabilitated sewers is based on their rehabilitation or replacement date. Table 2-3 lists the total length of sewer rehabilitated or replaced each year.

Table 2-2 Age of Gravity Sewers

Basin	Average Age of All Sewers[a] (yrs)	Avg. Age of Non-Rehabilitated Sewers (yrs)	Total Length[b] (ft)	Length of Rehabilitated Sewers (ft)	Percent Rehabilitated to Date
1	25	25	3,560	-	0.0%
2	30	40	35,550	9,100	25.6%
2C	40	55	6,120	2,300	37.6%
3	35	50	26,580	10,460	39.4%
4	10	35	18,690	13,780	73.7%
5	35	40	24,630	7,310	29.7%
6	45	55	31,530	7,550	23.9%
7	45	45	12,800	410	3.2%
8A	50	70	47,730	16,450	34.5%
8C	55	60	39,730	7,070	17.8%
9A	30	35	9,720	1,530	15.7%
9B	45	60	9,240	2,430	26.3%
10A	50	70	19,030	5,810	30.5%
10B	40	65	26,550	12,710	47.9%
11	40	45	18,080	1,380	7.6%
12	30	45	34,300	13,330	38.9%
13	50	65	27,880	7,810	28.0%
14	25	35	7,330	3,200	43.6%
15	40	50	19,970	3,550	17.8%
San Carlos	20	35	7,020	3,900	55.5%
San Mateo	55	60	4,570	570	12.5%
System-Wide	**40**	**55**	**430,620**	**130,650**	**30.3%**

a. Age in year 2007, rounded to nearest 5 years. For rehabilitated pipes, age based on year rehabilitated.
b. Lengths rounded to nearest 10 ft.

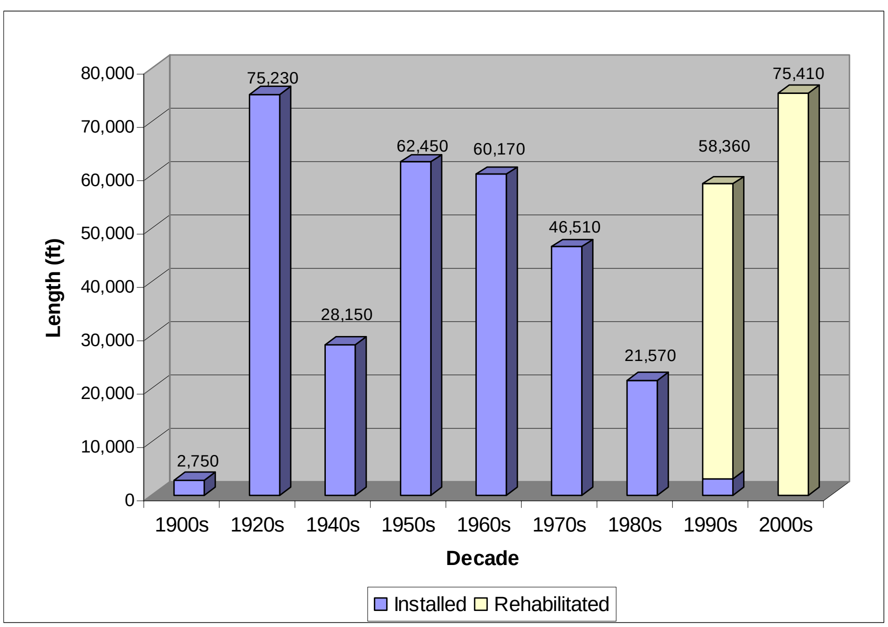
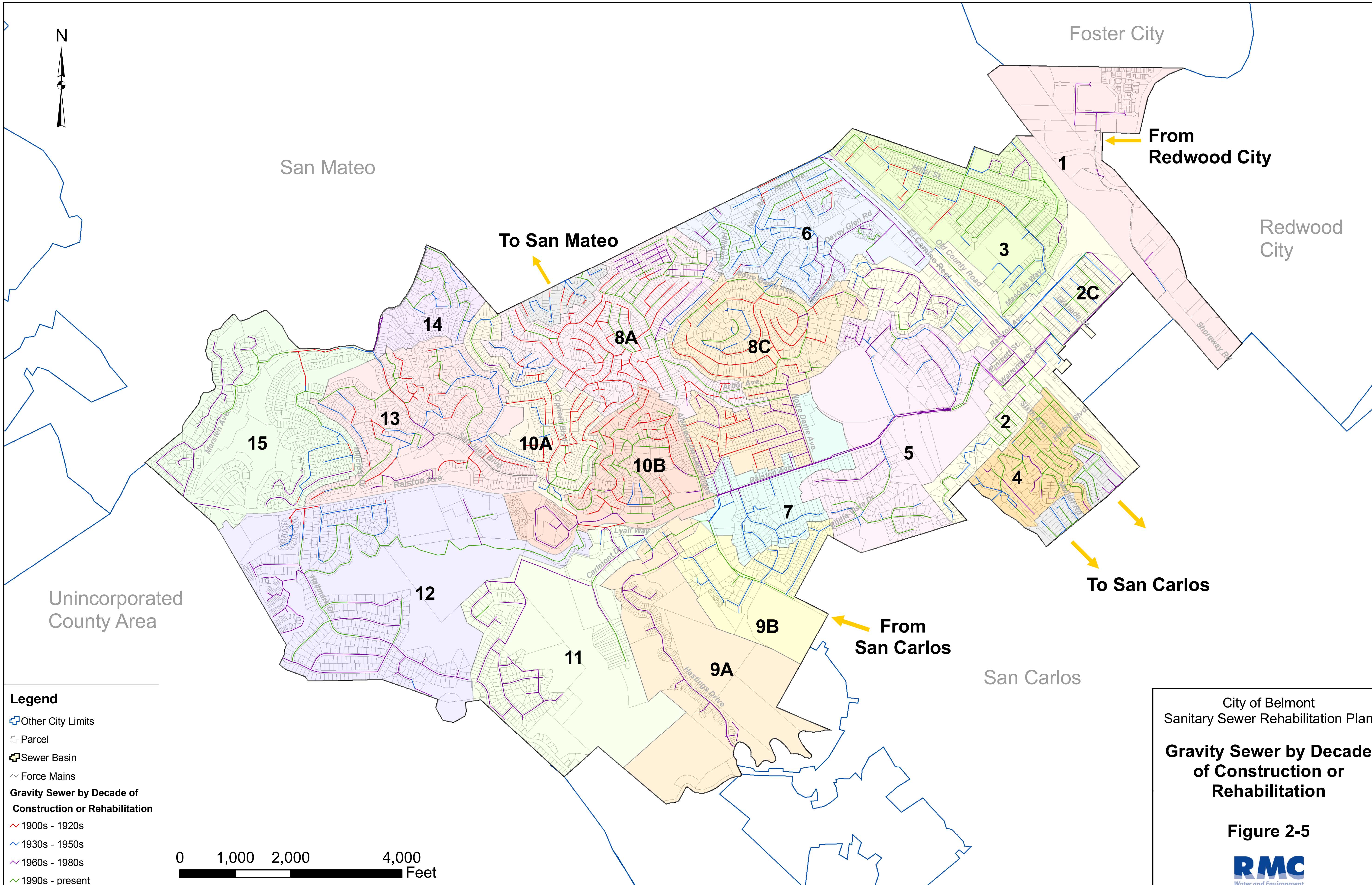


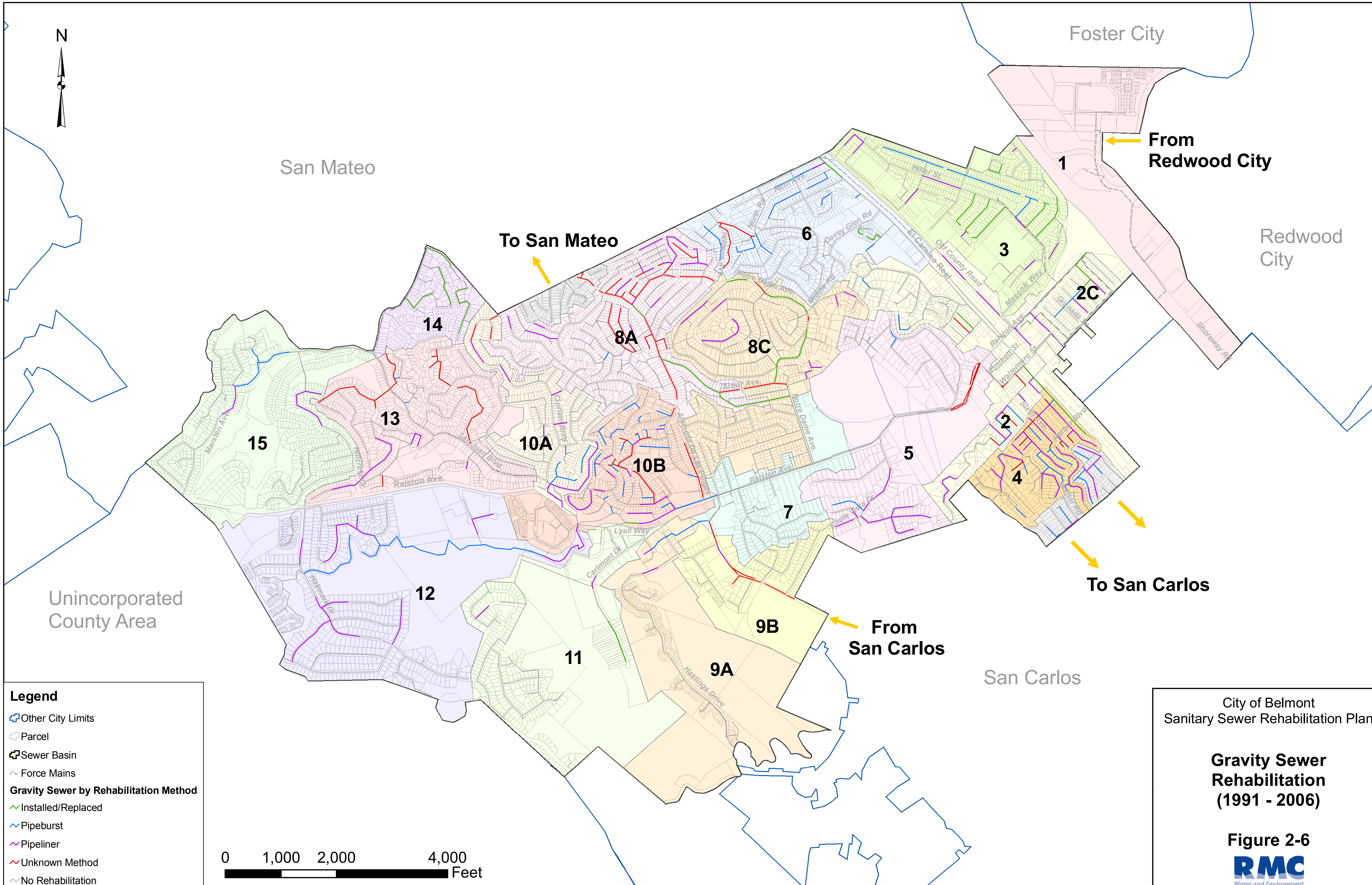
Figure 2-4 Length of Gravity Sewers Installed or Rehabilitated by Decade



City of Belmont
Sanitary Sewer Rehabilitation Plan

Gravity Sewer by Decade of Construction or Rehabilitation

Figure 2-5



City of Belmont
Sanitary Sewer Rehabilitation Plan

Gravity Sewer Rehabilitation (1991 - 2006)

Figure 2-6

RMC Water and Environment

Table 2-3 Length of Gravity Sewers Rehabilitated or Replaced, 1991 - 2006

Year	Length (ft)
1991	4,320
1992	0
1993	14,170
1994	0
1995	7,610
1996	0
1997	4,800
1998	17,760
1999	4,490
2000	2,270
2001	28,220
2002	1,560
2003	7,430
2004	0
2005	27,370
2006	8,570
Total	**130,650**

Table 2-4 shows the pipe materials in the gravity sewer system and their relative age. Figure 2-7 shows the distribution of pipe material in the system, and Figure 2-8 shows a map of the gravity system material. As in most collection systems in the San Francisco Bay Area, most of the gravity sewers are made of vitrified clay pipe (VCP). New sewers have typically been constructed of PVC pipe, and rehabilitated sewers have typically been replaced with or lined with plastic pipe (PVC or HDPE).

Table 2-4 Length and Average Age of Gravity Pipe Material

Pipe Material	Length[a] (ft)	Average Age[b] (yrs)	Percent
High-Density Polyethylene (HDPE)	29,900	5	6.9%
Polyvinyl Chloride (PVC)	37,200	15	8.6%
Vitrified Clay Pipe (VCP)	359,970	45	83.6%
Unknown	3,550	40	0.8%
Grand Total	**430,620**	**40**	**100.0%**

a. Lengths rounded to nearest 10 ft
b. Age in year 2007, rounded to nearest 5 years. For rehabilitated pipes, age based on year rehabilitated.

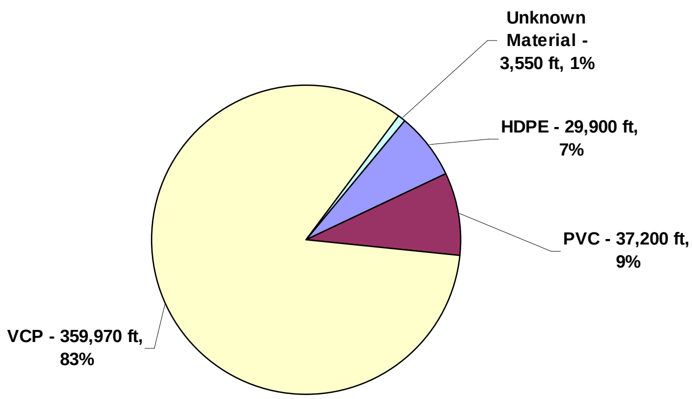
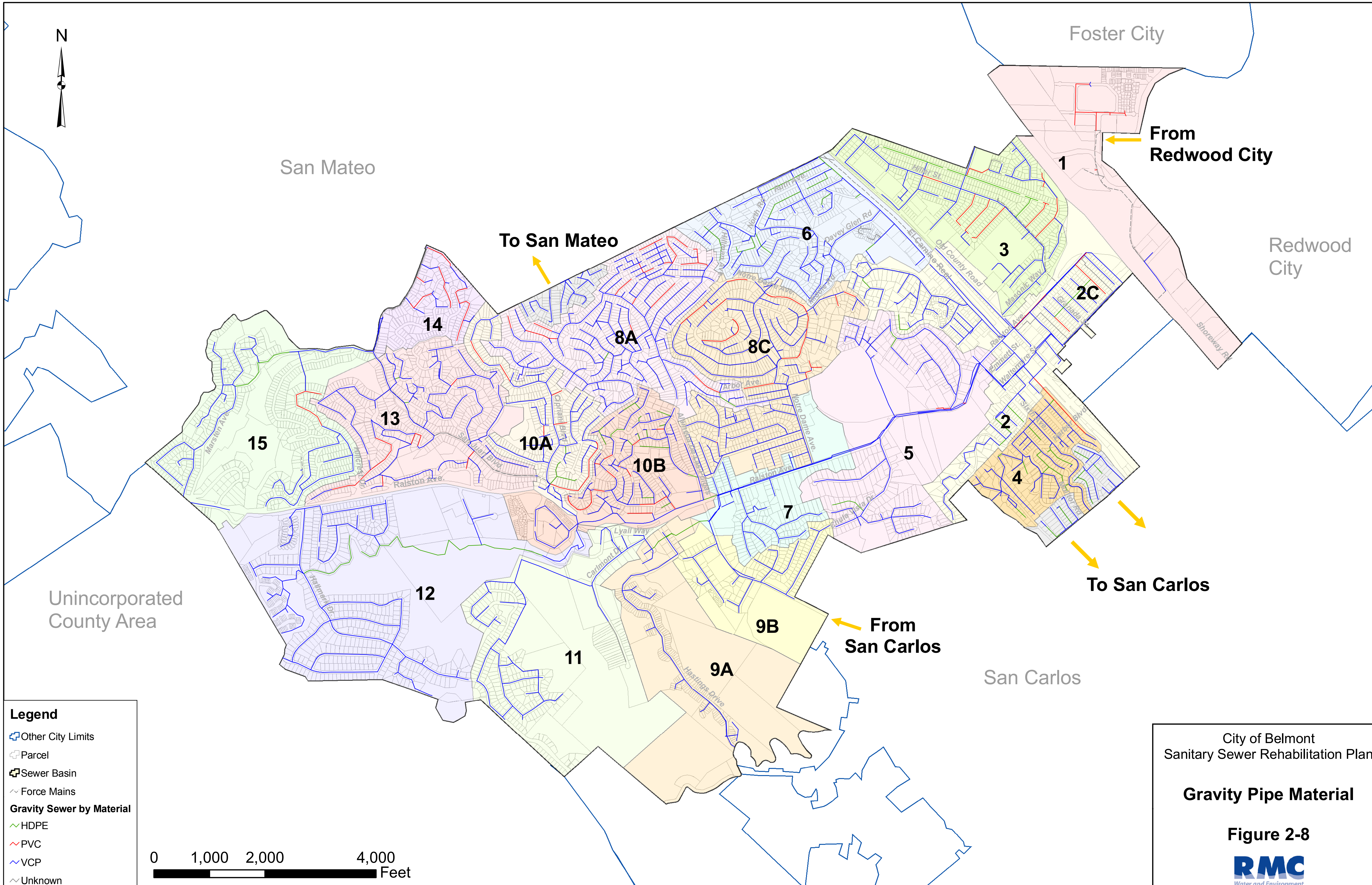


Figure 2-7 Distribution of Pipe Material in Sewer System



City of Belmont
Sanitary Sewer Rehabilitation Plan

Gravity Pipe Material

Figure 2-8

RMC Water and Environment

2.4 Gravity Sewer System Maintenance

The City implements an on-going preventive maintenance program for the gravity sewer system. The program includes selective cleaning of problem lines on 6-month and 12-month frequencies, and cleaning of the remaining lines in conjunction with CCTV inspection. The City also conducts root foaming in areas with root problems. Much of the maintenance focus is in the hilly areas with trees and areas with the highest rates of service calls. The majority of service calls are regarding sewer laterals, which are not the responsibility of the City but of the property owner. The highest volume of calls occurs during wet weather, especially in the hilly areas.

The City keeps records of its maintenance activities by date, address, and assessor parcel number. Using this data, maintenance jobs conducted from 1996 through 2006 were tabulated by basin. Figure 2-9 shows the total number of maintenance jobs per 1,000 feet of pipe for each sewer basin.

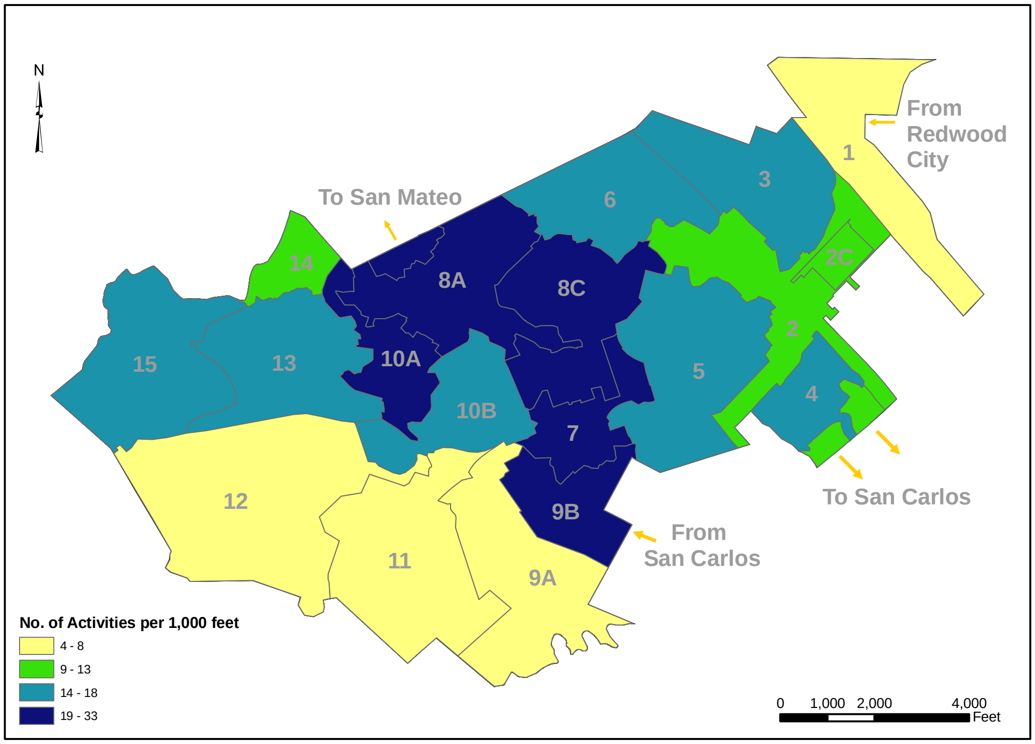


Figure 2-9 Number of Maintenance Activities per 1,000 Feet of Pipe (1994 – 2006)

2.5 Pump Stations and Force Mains

As shown in Figure 2-1, the Belmont collection system includes 11 sewage pump stations and associated force mains. The largest station is the San Juan Pump Station, which pumps the combined flow from sewer Basins 13, 14, and 15. Other stations serving significant areas are Hiller Street (Basin 3), North Road (Basin 6), and Haskins (Basin 14). The remaining stations are smaller and serve local neighborhoods. Hiller Street pump station, originally constructed in 1953, was the first pump station built, but has since been reconstructed. Table 2-5 summarizes information about the pump stations, as provided by the City.

Table 2-5 Pump Station Summary

Pump Station	Original Year Built	Rehabilitation or Upgrades	No. of Pumps	Pump hp	On-Site Emergency Generator
El Camino	1980s	1996 – Pumps replaced	2	¾	none
Haskins	1982		2	20	none
Hastings	1974		2	20	none
Hiller	1953	1998 – Reconstructed	2	20	none
Island Park #1	1989		2	10	none
Island Park #2 (at baseball field)	1988		2	2	none
Motel	1969	Early 1990s – Upgraded	2	2	none
Naughton	1994		2	10	none
North Road	1960	2002 – Reconstructed 2005 – Pumps replaced	2	34.5	none
Ralston Ranch	1996		2	10	none
San Juan	1956	1977 – Extensive modifications 1990 – Replaced one pump and motor 1997 - Reconstructed	2	120	125 KW

An evaluation of the City's pump stations was conducted in 1996 (Brian Kangas Foulk, City of Belmont Sanitary Sewer Pump Station Report, February 1996). At that time, there were eight pump stations in the system. The Pump Station Report recommended a number of improvements needed to comply with wastewater pump station reliability recommendations proposed in 1995 by the Regional Board. A number of the recommended pump station improvements were implemented by the City, and the City plans to implement additional improvements in the near-term.

Force main materials include ductile iron pipe (DIP), cast iron pipe (CIP), asbestos cement pipe (ACP), and plastic (HDPE) pipe. Table 2-6 summarizes force main characteristics, as provided by the City.

Table 2-6 Force Main Summary

Force Main Name	Year Built	Diameter (in)	Material	Length (ft)
El Camino at Harbor Blvd	1985[a]	4	CIP	100
Haskins / East Laurel Creek	1982	6	CIP	2,200
Hastings	1970[a]	6	CIP	900
Hiller	1953	10	ACP	1,300
	1998	10	HDPE	500
Island Park #1	1989	6	CIP	2,300
Island Park #2	1988	2	CIP	250
Naughton	1994	6	DIP	400
North Road / El Camino Real	2002	8	DIP	100
	1960[a]	8	ACP	3,300
Ralston Ranch	1996	6	DIP	600
San Juan	1977	12	DIP	5,000
			Total Length:	17,000

a. Approximate year built

The metal pipes (DIP and CIP) are of particular concern due to the potential for corrosion. An assessment of the San Juan DIP force main was conducted in 2005, and other force main evaluations have been conducted over the past ten years. Some force mains have also been replaced. In general, there are no known urgent force main problems, but the City recognizes that periodic force main assessments and eventual replacement, particularly of the older metal pipes, will be needed.

Chapter 3 Flow Monitoring and I/I Analysis

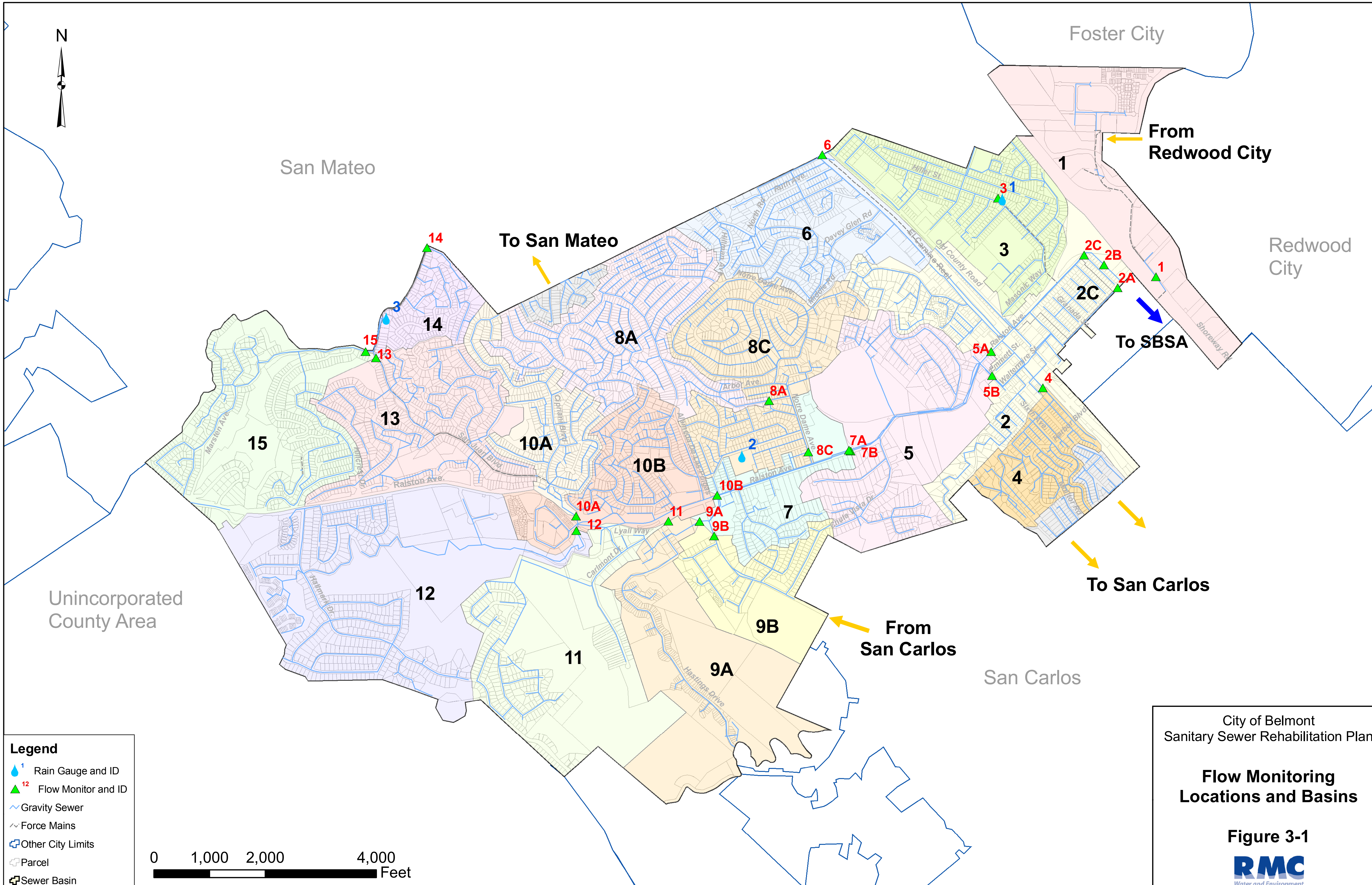
A flow monitoring program conducted in winter 2005/2006 provided the basis for identifying areas of the City with relatively high inflow and infiltration (I/I). This chapter discusses the flow monitoring program, and presents the analysis of the flow monitoring data. Recommendations for addressing I/I in the City's sewer system are also provided.

3.1 Flow Monitoring Program

The main purpose of monitoring sewer flow and rainfall was to measure existing flow conditions in the system during the wet weather season. E2 Consulting Engineers collected flow monitoring and rainfall data in the study area from late December 2005 through early March 2006. Twenty-two flow meters were installed throughout the City as shown in Figure 3-1. The figure also shows the areas (sewer basins) that contribute flow to each meter. Table 3-1 lists the flow meters and the information about each meter site. Three of the metering sites (Sites 3, 6, and 14) were located at pump stations (Hiller, North Road, and Haskins, respectively), and were metered using pump runtime recorders and calibrated by conducting pump drawdown tests. (Two other pump stations, San Juan and Island, were metered as backup sites, but the data were not used for analysis). The other sites utilized open channel depth-velocity flow meters, known as area-velocity (AV) meters. Concurrent with the wet weather flow monitoring, three rain gauges were placed throughout the City. The locations of the rain gauges were Hiller Pump Station (Gauge 1), Barrett Community Center (Gauge 2), and the San Juan Pump Station (Gauge 3). The rain gauge locations are also shown in Figure 3-1.

During the flow monitoring period, all of the monitoring sites were visited approximately once per week to check meter operation and site conditions, obtain field calibration measurements, and download collected data. Field calibration involved taking manual depth measurements and flow velocity measurements using a portable velocity meter. These calibration measurements were compared to and used to adjust monitor-recorded depth and velocity if needed. Calibration measurements were taken at different times of day in order to obtain a sufficient number of calibration points for the full range of typical diurnal flows. E2 and RMC reviewed the collected flow and rainfall data as it was collected throughout the monitoring period. Appendix A contains plots of the flow at each monitor site for the entire monitoring period. In addition, E2 prepared a summary report containing 7-day graphs of the data and summary tables of minimum, maximum, and average daily flows and rainfall. The flow monitoring data were used directly for I/I analysis.

A total of approximately 14 inches of rain fell during the flow monitoring period (December 20, 2005 through March 7, 2006). The largest storms occurred in late December and early January, and in late February and early March. Most of the month of February was a relatively dry period with little or no rainfall.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Flow Monitoring Locations and Basins

Figure 3-1

RMC Water and Environment

Table 3-1 Flow Monitoring Locations

Flow Monitor ID	Location	Manhole Number	Pipe Size (in.)
1	On Shoreway Road (near block 1301)	403702	6
2A	On O'Neill St, at intersection of O'Neill and Kedith St	403708	21
2B	In a parking lot, near Kedith St, Ralston, and Hwy. 101	403415	27
2C	Corner of Kedith St and Ralston	403404	12
3	Hiller Pump Station	n/a	n/a
4	On El Camino Real (near block 1336), near O'Neill Ave and Broadway	452404	10
5A	On Ralston (near block 891), near Sixth Ave	451803	18
5B	On Sixth Ave, at intersection with Emmett St	451808	18
6	North Road Pump Station	n/a	n/a
7A	On Ralston (near block 1525), near Notre Dame University	451003	15
7B	On Ralston (near block 1525), near Notre Dame University	451007	18
8A	On Fairway, at intersection of Fairway Drive with Francis Ave	443306	12
8C	On Notre Dame Ave near Ralston, near block 912	443205	15
9A	In a parking lot, near Alameda De Las Pulgas	450206	8
9B	On Alameda De Las Pulgas	450203	10
10A	On Ralston Ave, near Prindle Road and Continentals Way	453715	8
10B	On Ralston Ave, near intersection with Villa Ave	450420	12
11	On Merry Poppet, near School	unknown	10
12	In a parking lot, near intersections of Lyall Way and Continentals Way	453710	10
13	On San Juan Blvd, about 100 ft south of intersection with East Laurel Creek	431604	6
14	At Haskins Pump Station	n/a	n/a
15	On East Laurel Creek Road, about 100 ft west of intersection with San Juan Blvd	431601	10

3.2 I/I Analysis

There are two basic types of I/I: groundwater infiltration (GWI) and rainfall-dependent I/I (RDI/I). GWI enters the sewer system from underground through cracks and defects in sewer pipes, manholes, and service laterals. This type of infiltration varies depending on the location and condition of the sewers, type of soil and relative location of the groundwater table, and is typically greater in late winter and spring following the rainy season when groundwater levels are higher. RDI/I occurs during and immediately following rainfall events and results from either direct inflow of rain water (e.g., illegal connections of roof leaders, yard or driveway drains, or other types of direct drainage connections, or street runoff entering through manhole covers) or from infiltration through temporarily wet soils and into defects in laterals, mains, and manholes. The following subsection discusses and presents the results of the GWI and RDI/I analyses.

3.2.1 Groundwater Infiltration

The GWI analysis was performed for the dry weather (non-rainfall) periods of the flow monitoring program, which included most of the month of February 2006. An average daily dry weather flow (DWF) was estimated by averaging the flow over a selected seven-day period for each metering site. For meter sites that isolate a specific sewer basin (Basins 1, 2C, 3, 4, 6, 8A, 9A, 9B, 11, 12, 13, 14, and 15), the meter DWF represents the basin flow. To estimate the daily DWF for basins that represent the "incremental areas" between a downstream meter and one or more upstream meters (Basins 2, 5, 7, 8C, 10A, and 10B), the basin DWF was calculated by subtracting the flows at the upstream meter(s) from flows at the downstream meter, in order to isolate the flow for the tributary area between the meters. In addition to the meter DWF estimates, the DWF for the entire system was determined by review of flow data for the Belmont (Shoreway Road) Pump Station obtained from SBSA. Because an entire year of data was available for this location, daily flows during summertime and wintertime dry weather periods could also be compared.

Table 3-2 shows the average and minimum daily DWF by meter for the flow monitoring period and the total daily summertime and wintertime DWF for the Shoreway Pump Station. As indicated in the table, the daily summertime flow (July through October 2006) for the entire system was about 1.7 million gallons per day (mgd), compared to the daily flow during the dry portion of the flow monitoring period (February 5-25, 2006) of about 1.8 mgd.

Table 3-2 DWF Estimates by Meter

Meter	Avg. DWF (mgd)	Min. DWF (mgd)	Min./Avg. Ratio
1	0.017	0.001	0.08
2A*	0.653	0.169	0.26
2B*	1.263	0.405	0.32
2C	0.043	0.011	0.26
3	0.298	0.125	0.42
4	0.174	0.108	0.62
5A*	0.487	0.186	0.38
5B*	0.706	0.205	0.29
6	0.159	0.020	0.13
7A*	0.607	0.150	0.25
7B*	0.596	0.239	0.40
8A	0.253	0.067	0.26
8C*	0.470	0.150	0.32
9A	0.054	0.010	0.18
9B	0.203	0.105	0.52
10A*	0.249	0.082	0.33
10B*	0.906	0.264	0.29
11	0.126	0.020	0.15
12	0.113	0.045	0.40
13	0.171	0.058	0.34
14	0.015	0.000	0.00
15	0.088	0.007	0.08
Shoreway PS:			
Summer	1.73		
Winter	1.80		

* Represents multiple upstream basins.

Two types of analyses were attempted to estimate GWI in the system. The first involved estimating the theoretical daily wastewater flow based on water use data, and then comparing this flow to the metered DWF. Wintertime water use, when outside irrigation uses are minimal, provides a good estimate of actual wastewater discharged to the system. By subtracting out an allowance of about 10 percent to account for water consumed or used for irrigation (i.e., not discharged to the sewer system), the theoretical wastewater discharge is estimated to be about 90 percent of winter water use. Theoretically, the difference between metered wastewater flow during non-rainfall periods and theoretical wastewater discharge should represent GWI.

The City provided winter water use data by parcel for the entire City. Based on this data, the theoretical wastewater discharge was estimated for each basin and for the total system. However, some basins showed a higher wastewater discharge (based on water use) than monitored flow, illustrating the difficultly of using this type of analysis for estimating GWI. The need to subtract meter flows to determine flows for incremental basins also induces potential error in these calculations. For this reason, the subtraction of winter water use from metered flow proved not to be an effective way for estimating GWI in the Belmont sewer system.

On an overall system basis, however, the theoretical wastewater discharge based on winter water use is about 1.7 mgd, or about equal to the summertime daily flow at the Shoreway Pump Station. This indicates that there is little or no measurable summertime GWI in the Belmont system. Based on the Shoreway Pump Station daily DWF during the wintertime (1.8 mgd, as noted above), the total system GWI during the winter is estimated to be about 0.1 mgd.

Another method of assessing GWI is to compare metered minimum and average flows during dry weather periods. For meter areas in primarily residential communities such as Belmont, minimum flows will typically be 0.1 to 0.4 times average daily flows. Elevated minimum flows, as indicated by minimum to average flow ratios greater than about 0.5, indicate the possible presence of higher-than-normal GWI. As indicated in Table 3-2, two of the meter basins, Basins 4 and 9B, indicated relatively high minimum to average flow ratios.

The estimated GWI on a unit area basis was estimated for the overall system and for Basins 4 and 9B. The sewered area of the system was computed as the total area less any open space areas in each basin, and was estimated using a calculator in ArcGIS. Results of the GWI analysis indicate that the overall GWI rate in the Belmont system is approximately 50 gallons per day per acre (gpad), and the estimated GWI rates in Basins 4 and 9B are approximately 2,000 and 1,000 gpad, respectively. A GWI rate of 50 gpad is very low, and indicates that GWI is not a significant I/I component in Belmont. The high GWI estimated for Basins 4 and 9B may indicate a localized problem that suggests that these basins should possibly be given a higher priority for sewer rehabilitation. However, these two basins represent only about six percent of the total area of the system, so the total flow impact would likely be minimal.

The GWI analysis also indicates that there is no evidence of temporarily elevated GWI during the wet weather season. Although wastewater flows increase significantly during storm events, flows typically return to normal pre-storm levels within a few hours after the storm, and at most within two or three days. This held true for most of the meters for the four major storm events observed during the flow monitoring period, implying that elevated flows were mainly due directly to rainfall events.

3.2.2 Rainfall-Dependent I/I Analysis

The RDI/I analysis focused on assessing the relative magnitude of RDI/I at each flow meter during the four major storm events that occurred during the flow monitoring period: (1) December 30-31, 2005 (2) January 2, 2006 (3) February 26-27, 2006 and (4) March 5-6, 2006. These storms produced rainfall varying from about 1.3 to 2.7 inches over 24- to 48-hour periods. The largest event was the one on December 30-31, a storm that produced severe flooding in other parts of the Bay Area.

The basic methodology was to observe the typical flow response at the meters, compute the wet weather peaking factor (ratio of peak hourly flow during the storms to average DWF), and estimate peak RDI/I rates on a unit areal basis. The results of the analysis were used to identify the basins with the highest RDI/I contributions.

Wet weather peaking factors were computed for each storm event for all meters. The highest peaking factors occurred during the December 30-31 and January 2 storms, the two largest events. Results of the wet weather peaking factor computations are summarized in Table 3-3 and Figure 3-2. In Figure 3-2, the blue bars indicate the average wet weather peaking factor, and the lines indicate the range for the four analyzed storm events. Note that the data presented in the table and figure represent peaking factors for *meters*, not specifically for *basins*. Therefore, the data represents the response from all basins upstream of each meter site.

Table 3-3 Estimated Wet Weather Peaking Factors[a]

Meter	Maximum[b]	Average[c]
1	3.9	2.8
2A*	9.1	7.0
2B*	6.5	5.2
2C	8.7	6.2
3[d]	3.7	3.3
4	7.2	5.2
5A*	12.5	7.7
5B*	7.4	5.7
6	6.3	4.6
7A*	9.3	7.2
7B*[e]	7.3	5.5
8A	7.1	5.1
8C*	8.7	5.2
9A	5.0	3.9
9B	3.1	2.7
10A*	11.5	7.7
10B*	4.6	2.7
11	4.9	4.0
12	7.1	6.3
13	4.1	3.7
14	15	10.5
15	15	9.6

a. Peaking factors are PWWF/ADWF, where PWWF is the peak wet weather flow due to a rainfall event and ADWF is the average daily flow during dry weather periods.
b. Peaking factor from the storm causing the highest flow response.
c. Average of peaking factors from all of the four major rainfall events.
d. Data from December 30-31 and January 2 storms for this site was not available.
e. Data from January 2 storm for this site was not available.
* Represents multiple upstream basins.

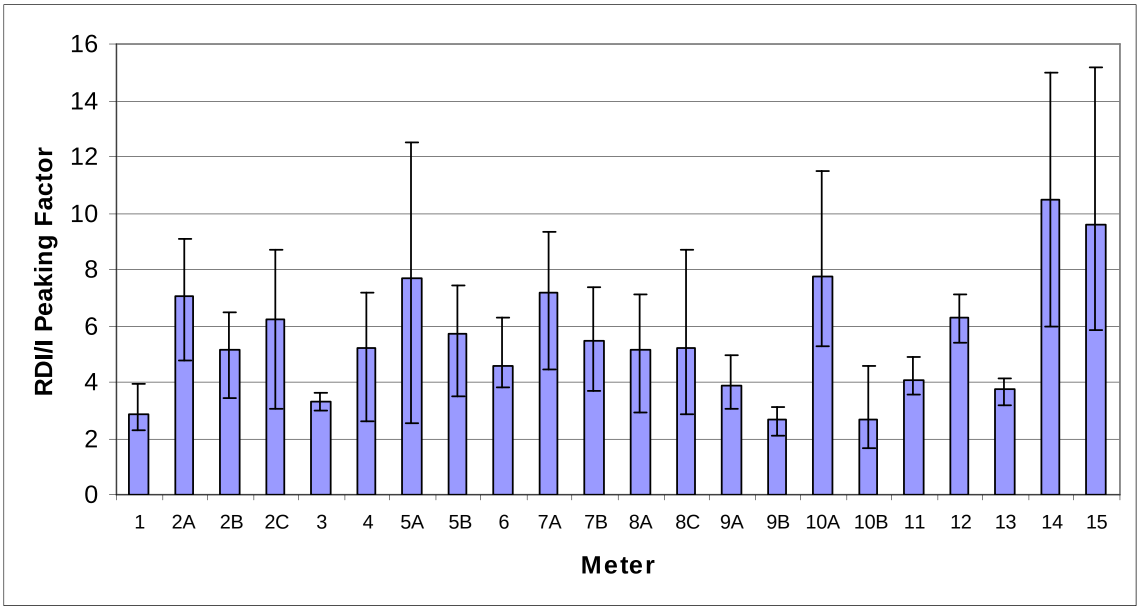


Figure 3-2 Wet Weather Peaking Factors

The data show the wet weather peaking factors in the Belmont system generally exceed 4:1 and are over 10:1 in some areas. Many of the meter sites surcharged (water level was higher than the crown of the sewer pipes) during the largest storm events in the monitoring period. The highest wet weather peaking factors occurred at meters 14 and 15, with peak flows reaching 15 times the average DWF at these sites during the December 30-31 storm, and averaging over 9 times average DWF for the four analyzed storm events. The peaking factors at meters 2A and 2B, which meter most of the flow from the system, averaged 5 to 7 times average DWF. These high peaking factors indicate that Belmont has significant RDI/I, which results in very high peak flows during rainfall events.

The peak flow from RDI/I in gallons per acre per day (gpad) was also estimated by basin for the analyzed storm events. This analysis could only be done for those meters that did not have multiple upstream basins. The analysis was done by subtracting the average DWF from the peak flow during the storms, and dividing the difference by the sewered area in each basin. The results of the analysis indicate that peak RDI/I rates generally range from about 2,000 to over 10,000 gpad in the Belmont system. The highest peak RDI/I rates occurred in Basins 2C, 4, 8A, 8C, and 15. The relative RDI/I rates by basin are shown in Figure 3-3.

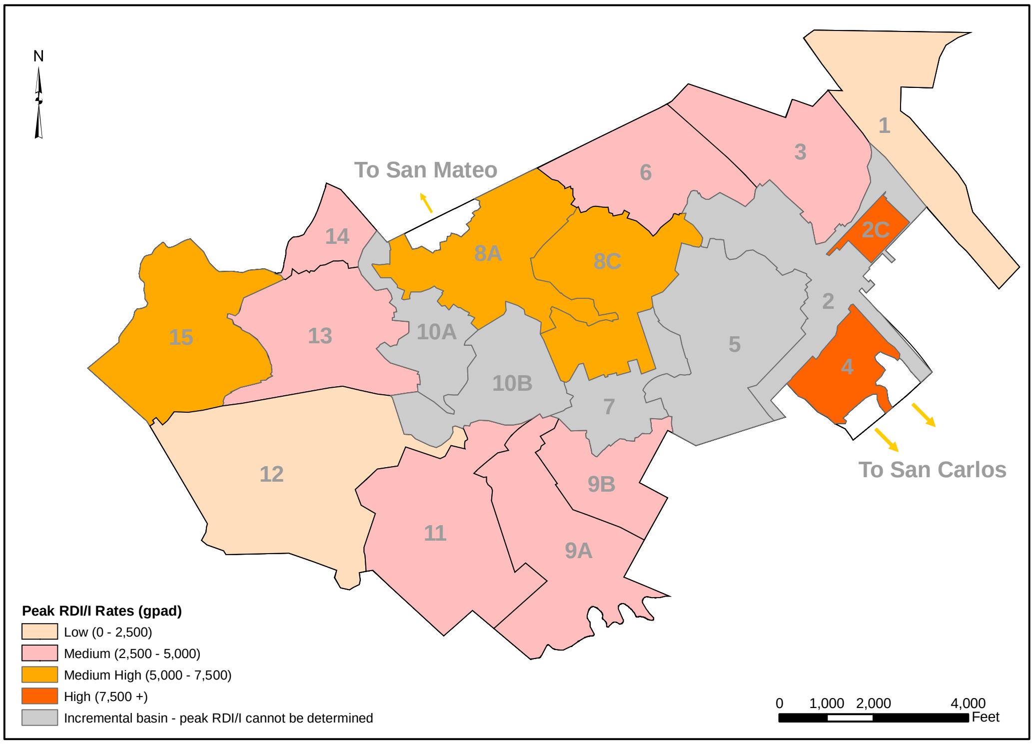


Figure 3-3 Relative RDI/I Rates

3.3 Recommendations for Addressing I/I

The flow monitoring data collected during this study, as well as the historical flow data for the SBSA Shoreway Pump Station, indicate that I/I is a significant component of peak wet weather flows in the Belmont system. As noted previously, peak wet weather flows typically range from 4 to as high as 10 times average dry weather flows in some areas. Over half of the flow meter sites surcharged during the large storm events of December 30-31, 2005 and January 2, 2006 that were monitored for this study, and some surcharged during other events as well. Peak flows to the Shoreway Pump Station have been known to exceed 12 mgd, the maximum flow rate that can be measured.

The high I/I in the Belmont system is typical of many older communities in the San Francisco Bay Area. Studies in other areas have shown that a large portion of the I/I originates from sewer laterals. Although Belmont has conducted a significant amount of sewer rehabilitation (almost 30 percent of its system to date), I/I remains high. This could be attributed to the fact that laterals have not been rehabilitated along with the mains. Furthermore, a large portion of the sewer rehabilitation work completed by the City has been by lining of sewer mains with internal reconnections of the laterals, which may leave a gap between the lined main and the lateral. The connections of the laterals to the sewer mains are believed to be a significant source of I/I in many older sewer systems. Therefore, the internal reconnections used in lining, while avoiding the need to excavate each lateral and thereby minimizing cost and disruption to city streets and neighborhoods, may fail to address a key point of entry of I/I into the system.

Many Bay Area communities that have specifically targeted sewer rehabilitation to reduce I/I have made the decision to include the lower portions of the sewer laterals (within the public right-of-way) as part of the public sewer project. While this adds cost to the project, it also increases the effectiveness of the sewer rehabilitation work in addressing I/I, and ultimately benefits the community by reducing potential maintenance problems (e.g., sewer lateral blockages and overflows) and by taking care of needed construction in street rights-of-way all at one time.

Some communities have also adopted private lateral compliance ordinances which require that laterals be tested or inspected at designated times, such as at the sale or transfer of the property or during a major remodel, and rehabilitated or replaced if the lateral fails the test or inspection. Some communities also offer financial assistance (in the form of grants or loans) for either mandatory or voluntary lateral rehabilitation.

To address the I/I problem, it is recommended that Belmont consider one or more of the following approaches:

- Implement external lateral reconnections or reconstruction, or a more effective method of sealing the lateral connection, for all sewer main rehabilitation.
- Rehabilitate or replace the lower portion of the service laterals whenever the sewer main is rehabilitated or replaced.
- Require property owners to test/inspect their sewer laterals whenever a public sewer main project is scheduled on their street, and repair or replace the lateral if it fails the test. The City could also ease the burden on these property owners, financial and otherwise, by arranging to contract for the lateral work through the sewer main construction contractor.
- Explore the possibility of implementing a private lateral compliance program that requires testing/inspection and rehabilitation, if necessary, of the lateral at sale or transfer of the property, and/or at other trigger points such as major remodels, changes in property use, whenever a sewer blockage occurs, or at designated intervals of time based on the age of the lateral.

Based on the estimated costs presented in Section 5.3, the estimated additional cost for including the lower laterals in public sewer rehabilitation projects would be approximately 20 percent more than the City’s current rehabilitation approach, depending on rehabilitation method used, but would likely provide benefits in terms of reduced I/I and service calls.

Chapter 4 Gravity Sewer Rehabilitation Needs Assessment

The City's gravity sewer pipeline asset data were analyzed to identify anticipated sewer rehabilitation needs for the next 25 years, and to prioritize these needs based on pipe age, magnitude of observed RDI/I, and maintenance history. This Chapter discusses the results of this analysis. This information provides a good basis for estimating the extent of anticipated rehabilitation needs in each basin. Specific pipes to be rehabilitated or replaced each year will be based on actual condition assessment data collected by the City through its on-going CCTV inspection program. Rehabilitation methods commonly used by the City are also discussed.

4.1 Material Service Life

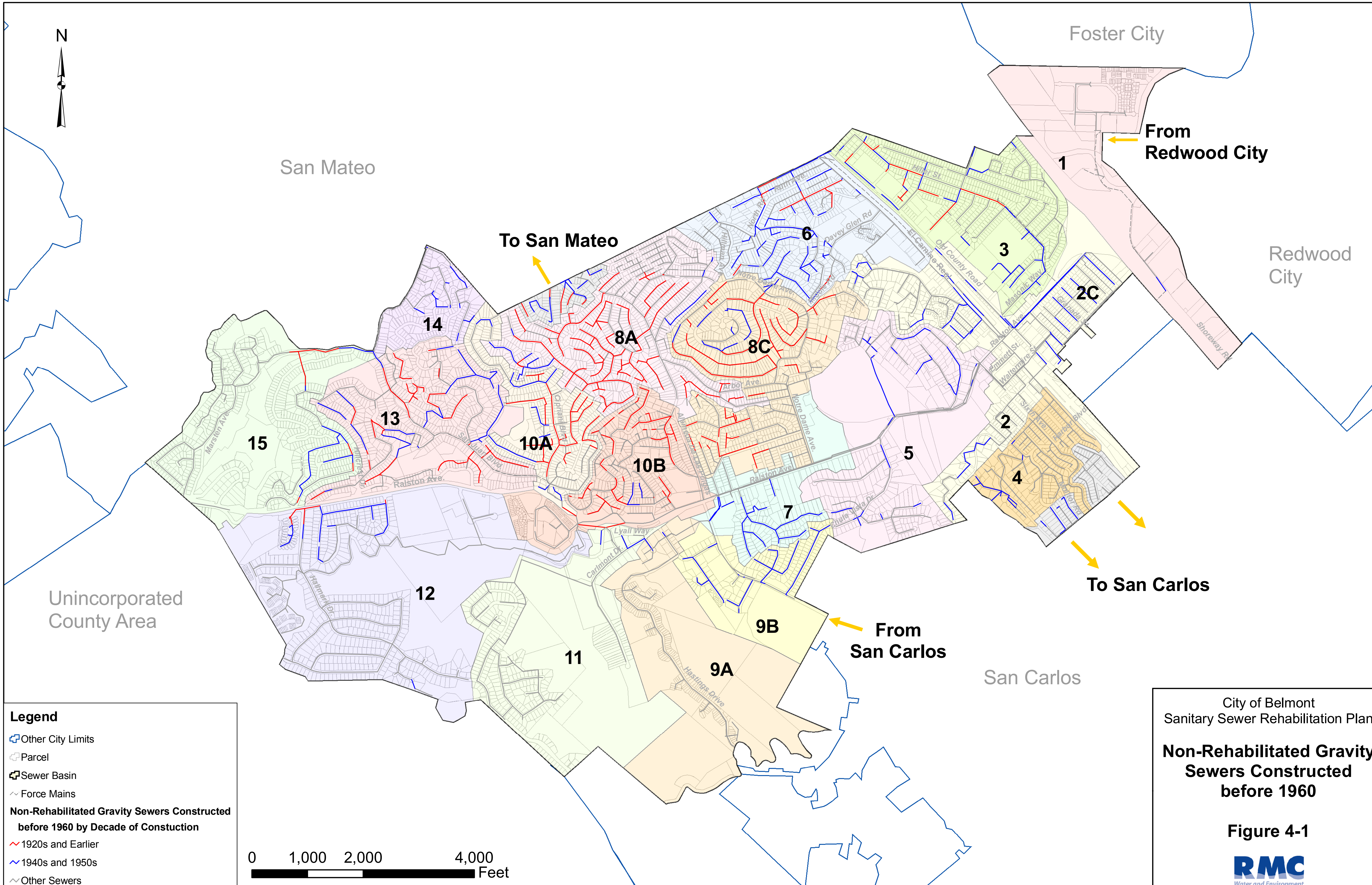
For the purposes of this plan, service life is considered to be the age at which deterioration and defect accumulation may begin to affect the structural integrity of a pipe or allow excess infiltration to occur. Although the service life of pipelines can vary greatly depending on construction methods and site-specific sewer conditions, it is very useful for anticipating future renewal or replacement requirements. Specific pipes may deteriorate sooner or later than anticipated, but an analysis of service life should provide a good estimate of the extent of anticipated rehabilitation needs on a system-wide basis.

As discussed in Chapter 2, nearly 85 percent of the City's gravity sewer pipelines are VCP, and nearly all pipe installed in the City through the 1980s is VCP. Although VCP can fail by cracking and breakage due to material brittleness, the integrity of the pipe joints is a key factor in determining the service life of VCP. Prior to approximately 1960, most VCP pipelines were constructed with inflexible cement mortar or bituminous joints, which are prone to failure and leakage. Since about 1960, VCP construction typically has used flexible gasket joints, which are less prone to failure and leakage than the inflexible joints. For this reason, VCP pipelines constructed prior to about 1960 are generally considered to have a useful service life of approximately 50 years, while VCP pipelines constructed after about 1960 are generally considered to have a useful service life of 75 years or longer.

By the 1990s, the City began installing predominantly plastic pipe (PVC and HDPE). Since the plastic pipe in the City's system is relatively new and is typically considered to have a long service life, it is anticipated that the City's plastic pipe will outlast the 25-year planning period of this study. Based on the expected service life of VCP as discussed above, VCP sewers installed after 1960 are also expected to outlast the planning period of this study. Therefore, the focus of the gravity sewer rehabilitation plan is rehabilitation of the City's VCP pipelines built before 1960.

4.2 Age Profile

As noted above, the focus of this plan is rehabilitation of the City's VCP pipelines built before 1960. Figure 4-1 presents a map showing the locations of non-rehabilitated gravity sewers constructed before 1960. Table 4-1 lists the length and percent of gravity pipe constructed before 1960 in each basin. Table 4-2 further divides these pipes into those constructed in the 1920s and earlier, and those constructed in the 1940s and 1950s (no pipes were constructed in the 1930s according to the City's asset database), and Figure 4-2 shows this information graphically.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Non-Rehabilitated Gravity Sewers Constructed before 1960

Figure 4-1

RMC Water and Environment

Table 4-1 Length of Non-Rehabilitated Gravity Sewers Constructed before 1960, by Basin

Basin	Total Length[a]	Length Constructed before 1960[a]	% Constructed before 1960
1	3,560	310	9%
2	35,550	10,950	31%
2C	6,120	3,500	57%
3	26,580	11,290	42%
4	18,690	1,900	10%
5	24,630	6,060	25%
6	31,530	15,920	50%
7	12,800	6,040	47%
8A	47,730	25,100	53%
8C	39,730	20,710	52%
9A	9,720	370	4%
9B	9,240	6,460	70%
10A	19,030	12,720	67%
10B	26,550	9,230	35%
11	18,080	1,720	10%
12	34,300	5,500	16%
13	27,880	17,550	63%
14	7,330	2,170	30%
15	19,970	5,570	28%
San Carlos	7,020	1,530	22%
San Mateo	4,570	3,980	87%
Total	**430,620**	**168,580**	**39%**

a. Length in feet. Lengths rounded to nearest 10 ft.

Table 4-2 Age Breakdown of Gravity Sewers Constructed before 1960, by Basin

Basin	Total Length[a]	Length 1920s or Earlier[a]	Length 1940s & 1950s[a]	% 1920s or Earlier
1	3,560	-	310	0%
2	35,550	-	10,950	0%
2C	6,120	-	3,500	0%
3	26,580	3,680	7,610	14%
4	18,690	-	1,900	0%
5	24,630	-	6,060	0%
6	31,530	3,330	12,590	11%
7	12,800	-	6,040	0%
8A	47,730	21,630	3,470	45%
8C	39,730	17,600	3,110	44%
9A	9,720	-	370	0%
9B	9,240	-	6,460	0%
10A	19,030	8,640	4,080	45%
10B	26,550	8,330	900	31%
11	18,080	870	850	5%
12	34,300	1,150	4,350	3%
13	27,880	9,490	8,060	34%
14	7,330	-	2,170	0%
15	19,970	2,010	3,560	10%
San Carlos	7,020	-	1,530	0%
San Mateo	4,570	1,250	2,730	27%
Total	**430,620**	**77,980**	**90,600**	**18%**

a. Length in feet. Length rounded to nearest 10 ft. No pipes constructed in 1930s. Oldest pipes built in 1907.

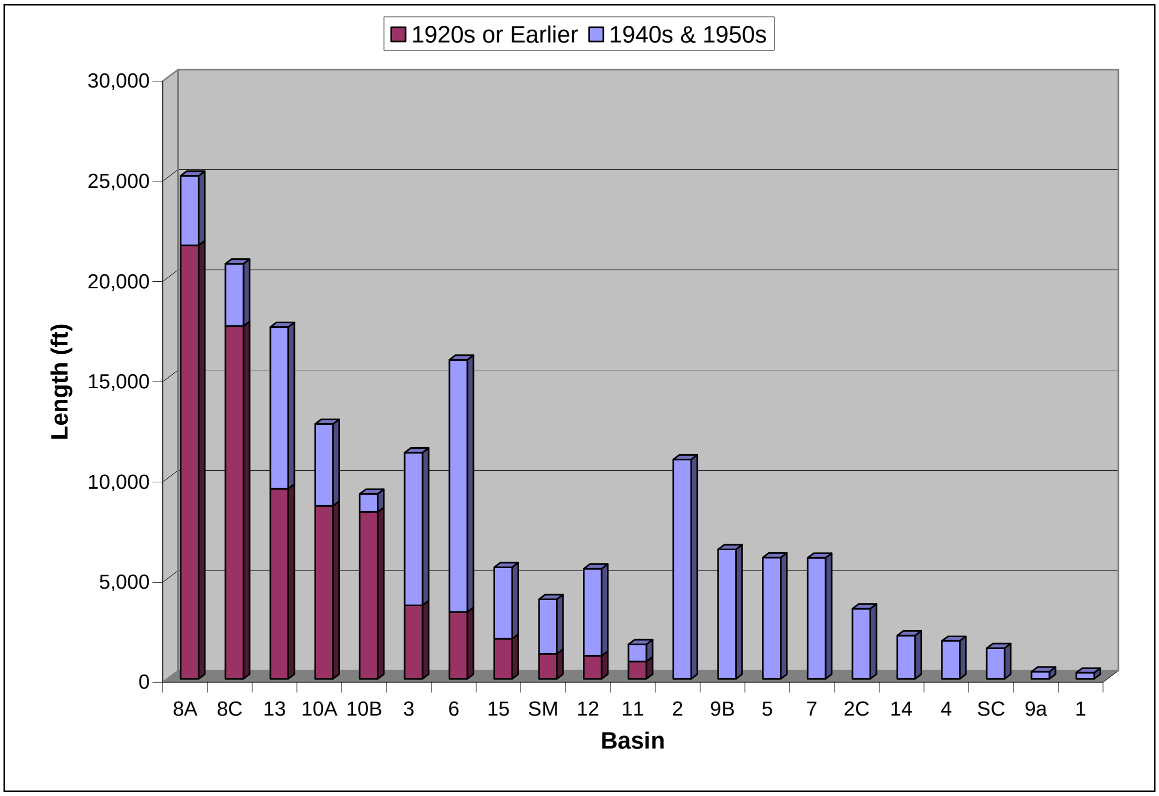


Figure 4-2 Length of Non-Rehabilitated Gravity Sewers Constructed before 1960, by Basin

Table 4-2 shows that nearly 20 percent of the gravity sewer pipes in the City (nearly half of the pipes constructed before 1960) were constructed in the 1920s or earlier, and are now about 80 years old or older. As illustrated on Figure 4-2, Basins 8A and 8C both have the longest length of gravity pipe constructed before 1960, over 20,000 feet each, as well as the longest length constructed in the 1920s or earlier, both with over 17,000 feet each. Based on Table 4-2, the length of pipe in these basins constructed in the 1920s or earlier accounts for about 45 percent of the total gravity pipe length in each of these basins.

Basins 13, 10A, and 10B have the next longest length of pipe constructed in the 1920s or earlier, each with over 8,000 feet.

4.3 Other Prioritization Factors

While age of pipes is the primary method of identifying and prioritizing anticipated rehabilitation needs, maintenance history and level of I/I can provide additional information for verification or prioritization of anticipated rehabilitation needs, when used in conjunction with the pipe age.

Maintenance history by basin was discussed in Chapter 2 and I/I was discussed in Chapter 3. For reference, figures showing the maintenance activity per 1,000 feet of pipe and the relative magnitude of peak RDI/I by basin are reprinted in this Chapter as Figure 4-3 and Figure 4-4.

Based on this information combined with the age of pipes, Basins 8A and 8C clearly are high priority areas to target for rehabilitation. These basins not only have the longest lengths (and highest percentages) of 80 year old or older sewers, but they are also in the highest category for maintenance activity as well as the second highest category for magnitude of RDI/I. The San Mateo Basin and Basins 10A, 10B, and 13 also seem to be relatively high priority basins, as they also have high percentages of pipes built in the 1920s or earlier (27 to 45 percent of the total length of pipe in the basins), as well as relatively high levels of maintenance activity.

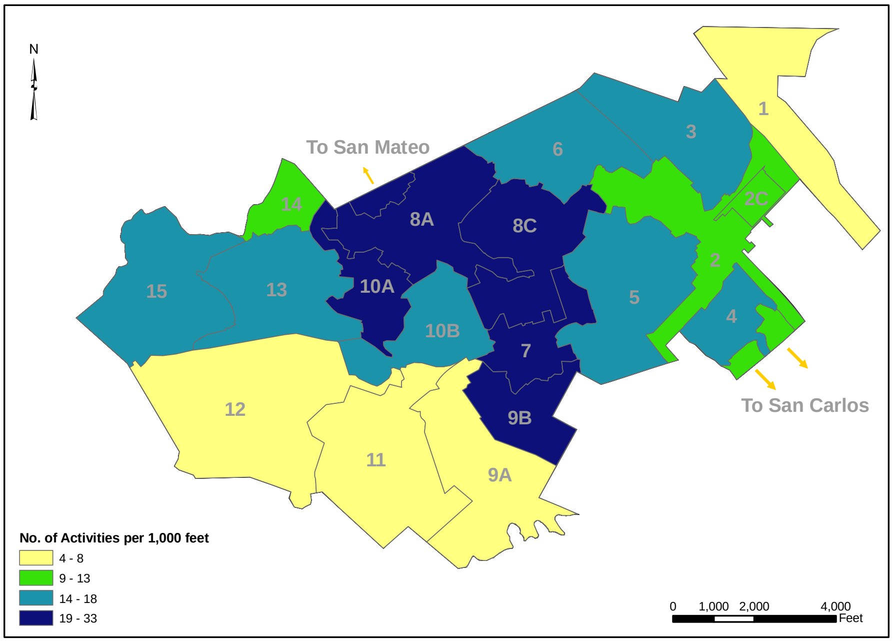


Figure 4-3 Number of Maintenance Activities per 1,000 Feet of Pipe (1994 – 2006)

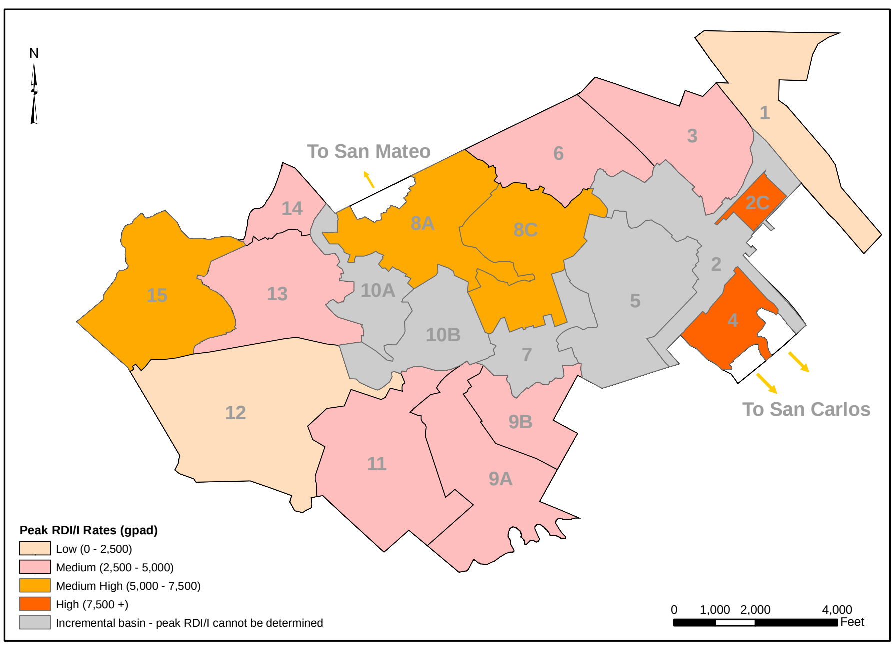


Figure 4-4 Relative RDI/I Rates

4.4 Gravity Sewer Rehabilitation Methods

The City's typical rehabilitation methods used for gravity sewer pipelines include pipe lining, pipe bursting, and open cut remove and replace, depending on the severity and type of defects and the location of the sewer. The following sub-sections briefly describe each of these rehabilitation methods.

4.4.1 Pipe Lining

The City uses both Cured-in-Place Pipe (CIPP) and Fold and Form pipe lining methods.

Cured-in-Place Pipe

CIPP is a rehabilitation process that involves the insertion of a flexible, resin-impregnated synthetic fabric liner into the sewer pipe. The liner is custom fabricated to match the inside dimensions and length of the sewer to be rehabilitated. Depending on the size of the pipe to be rehabilitated, the liner is either installed through an existing manhole or through an access pit and is then positioned in the deteriorated pipe. In situations where a segment of the existing pipe is missing and a void in the backfill exists, the area either needs to be spot repaired by surface excavation prior to lining, or the liner may be installed and the void filled by grout injection after the liner is cured. CIPP installation is shown in Figure 4-5.

Figure 4-5 CIPP Installation

The primary advantage of CIPP is that it is installed essentially without surface or underground utility disruption. It produces a seamless, jointless pipe lining with minimal reduction of the original pipe diameter and leaves no annular space to be grouted after the liner is installed. The principal disadvantage of CIPP is that all wastewater flow must be bypassed during the entire inversion process, which will impact installation costs depending on the amount of flow which must be diverted.

Folded Plastic Pipe Liner

Folded plastic pipe liner, also known as fold and form pipe or deformed/re-formed, is one of the fastest growing segments of the sewer rehabilitation market. All the manufacturers' processes are similar in that a jointless pipe which is deformed by means of thermomechanical deforming equipment into a "U" shape is sliplined into an existing pipeline, then the deformed shape is reformed to a circular shape with heat and hydraulic pressure, as shown in Figure 4-6.

Figure 4-6 Folded Plastic Pipe Liner Rehabilitation Method

As with all sewer rehabilitation projects, it is essential to inspect the existing pipeline by use of a CCTV camera. Protruding laterals and other obstructions must be removed prior to liner insertion. The advantages of this method include rapid installation, continuous pipe, and no joints. Excavation is not required for this process.

4.4.2 Pipe Bursting

Pipe bursting, also known as pipe displacement, is a technique for breaking out the old pipe by use of radial forces from inside the old pipe. Figure 4-7 shows a pipe bursting cutting wheel, and Figure 4-8 shows the pipe bursting process. The fragments are forced outward into the soil and a new pipe is pulled into the bore formed by the bursting device. The pipe bursting method creates no reduction in capacity; in fact, increases in capacity are possible. Upsizing of pipe by two pipe sizes is possible depending on soil conditions.

Figure 4-7 Pipe Bursting Cutting Wheel

Figure 4-8 Pipe Bursting Process

4.4.3 Remove and Replace (Open Cut)

The City uses open cut remove and replace when the pipe is too deteriorated to line. Remove and replace requires excavation of the surface along the pipe, as shown in Figure 4-9. Typical construction equipment includes an excavator or backhoe, crane, loader, compaction equipment, and dump trucks. The amount of area disturbed by the construction activities varies depending on pipe size, depth, soil type, and construction approach.

Figure 4-9 Open Cut Remove and Replace

Chapter 5 Rehabilitation Plan and CIP

This chapter presents the recommended Sanitary Sewer Rehabilitation Plan, including the estimated capital budgets needed for sewer system rehabilitation for the City's 5-year and 25-year Capital Improvement Programs. Although the focus of this study has been on the gravity sewer system, the Rehabilitation Plan also addresses the pump stations and force mains in the system based on specific information provided by City staff and general recommendations with respect to anticipated future needs for facility evaluations and repairs.

5.1 Near-Term Rehabilitation Plan

The following sub-sections present near-term evaluation and rehabilitation needs for gravity sewers, pump stations, and force mains, as identified by the City.

5.1.1 Near-Term Gravity Sewer Rehabilitation

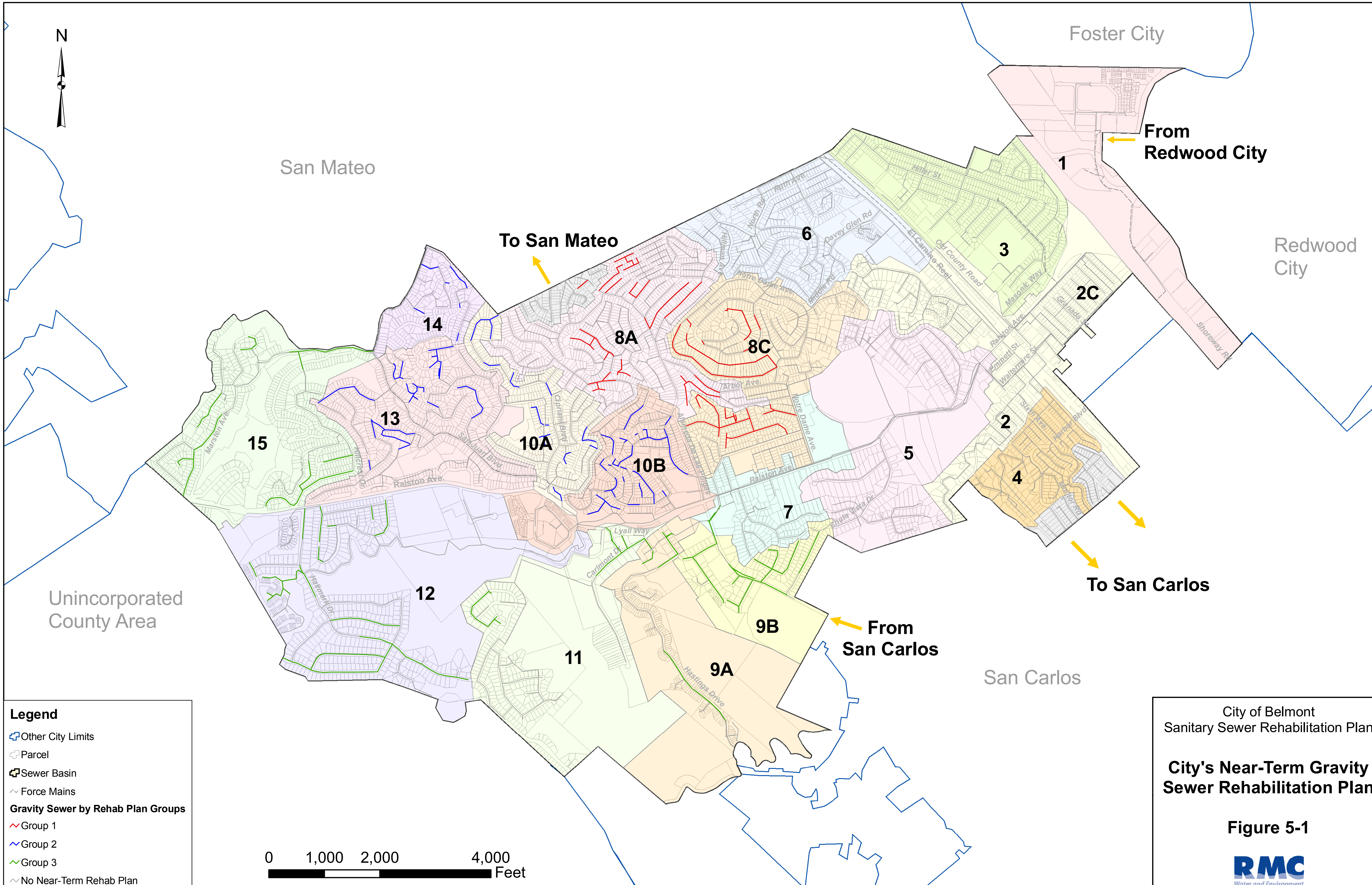
The City has identified gravity pipes intended for near-term rehabilitation. These projects should be completed within the next 10 years. The basins selected for rehabilitation each year are based on the City's on-going rehabilitation and CCTV inspection schedule. The City identifies the specific pipes to be rehabilitated or replaced based on CCTV inspection data. Table 5-1 lists the length of pipe in each basin that the City has identified for rehabilitation, grouped according to the order the City plans to complete the rehabilitation work. The length of pipe planned for rehabilitation that was constructed prior to 1960 is also included in Table 5-1 for reference. The pipes intended for rehabilitation are shown on Figure 5-1.

As discussed in Section 4.3, on a basin-wide basis, Basins 8A, 8C, 10A, 10B, and 13 are relatively higher priority due to their long lengths of old sewers, as well as relatively high RDI/I and/or maintenance activity. Therefore, it is appropriate that the City plans to target these basins first for rehabilitation work.

Table 5-1 City's Near-Term Rehabilitation Plan

Basin	Total Pipe Length Scheduled for Rehabilitation[a]	Length Constructed 1920s or Earlier	Length Constructed 1940s & 1950s
Group 1			
8a	10,330	5,800	0
8c	12,020	7,060	1,380
San Mateo	240	0	240
Group 2			
10a	4,220	1,210	1,960
10b	7,260	4,160	470
13	7,850	2,770	1,640
14	1,480	0	1,140
Group 3			
7	860	0	550
9a	3,410	0	330
9b	7,490	0	5,280
11	3,310	0	610
12	12,670	350	2,390
15	8,270	1,340	1,800
Total Near-Term	**79,410**	**22,700**	**17,790**

a. Pipe lengths rounded to nearest 10 ft.



City of Belmont
Sanitary Sewer Rehabilitation Plan

City's Near-Term Gravity Sewer Rehabilitation Plan

Figure 5-1

5.1.2 Near-Term Pump Station and Force Main Rehabilitation

Table 5-2 lists the City's pump stations and the near-term rehabilitation needs identified by the City for each station, along with the anticipated year of rehabilitation. All near-term pump station improvements should be completed within 10 years.

Table 5-2 City's Near-Term Pump Station Rehabilitation Needs

Pump Station	Rehabilitation Needs	Rehabilitation Time-Frame
El Camino	Needs evaluation and improvements	After 2011/2012
Haskins	Reconstruction already planned for 2006/2007. No additional near-term rehabilitation needs anticipated.	n/a
Hastings Pump Station	Rehabilitate pump station. New pumps, valves, control plan upgrades, new generator and canopy	Needs to be completed in 2007/2008
Hiller Pump Station	Emergency generator installation	Needs to be completed in 2007/2008
Island Park #1	Needs evaluation and improvements. Anticipated improvements include new generator; new control panel cabinet, cement pad, and cover; new guide rails, new conduit for transducer; mixer; and new lid for wet well.	2009/2010 through 2011/2012
Island Park #2	No near-term rehabilitation work anticipated	n/a
Motel	Needs evaluation and improvements. Anticipated improvements include new pumps, new control cabinet, cover for control panel, new check valves and water supply to pump station	2009/2010 through 2011/2012
Naughton	No near-term rehabilitation work anticipated	n/a
North Road	Emergency generator installation	Needs to be completed in 2007/2008.
San Juan	No near-term rehabilitation work anticipated	n/a
Ralston Ranch	Needs evaluation and improvements	After 2011/2012

The City does not anticipate any near-term force main replacement needs. However the City has identified force mains needing evaluation in the next 10 years. These include Haskins, Island Park #1, and Naughton pump station force mains in the near future, and San Juan, Hastings, and El Camino pump station force mains within 10 years.

5.2 Long-Term Rehabilitation Plan

The long-term rehabilitation plan is intended to cover the remaining rehabilitation needs over a 25-year period, not included in the City's near-term plan presented in Section 5.1. As discussed in Chapter 4, gravity pipes built before 1960 are anticipated to need rehabilitation during this period based on their expected service life. While this plan should provide a reasonable estimate of total pipe length in each basin to be rehabilitated during this timeframe, some pipes may deteriorate faster or slower than expected, and some newer pipes (constructed after 1960) may also require rehabilitation. Therefore, the specific pipes to be rehabilitated should be based on actual CCTV inspection data.

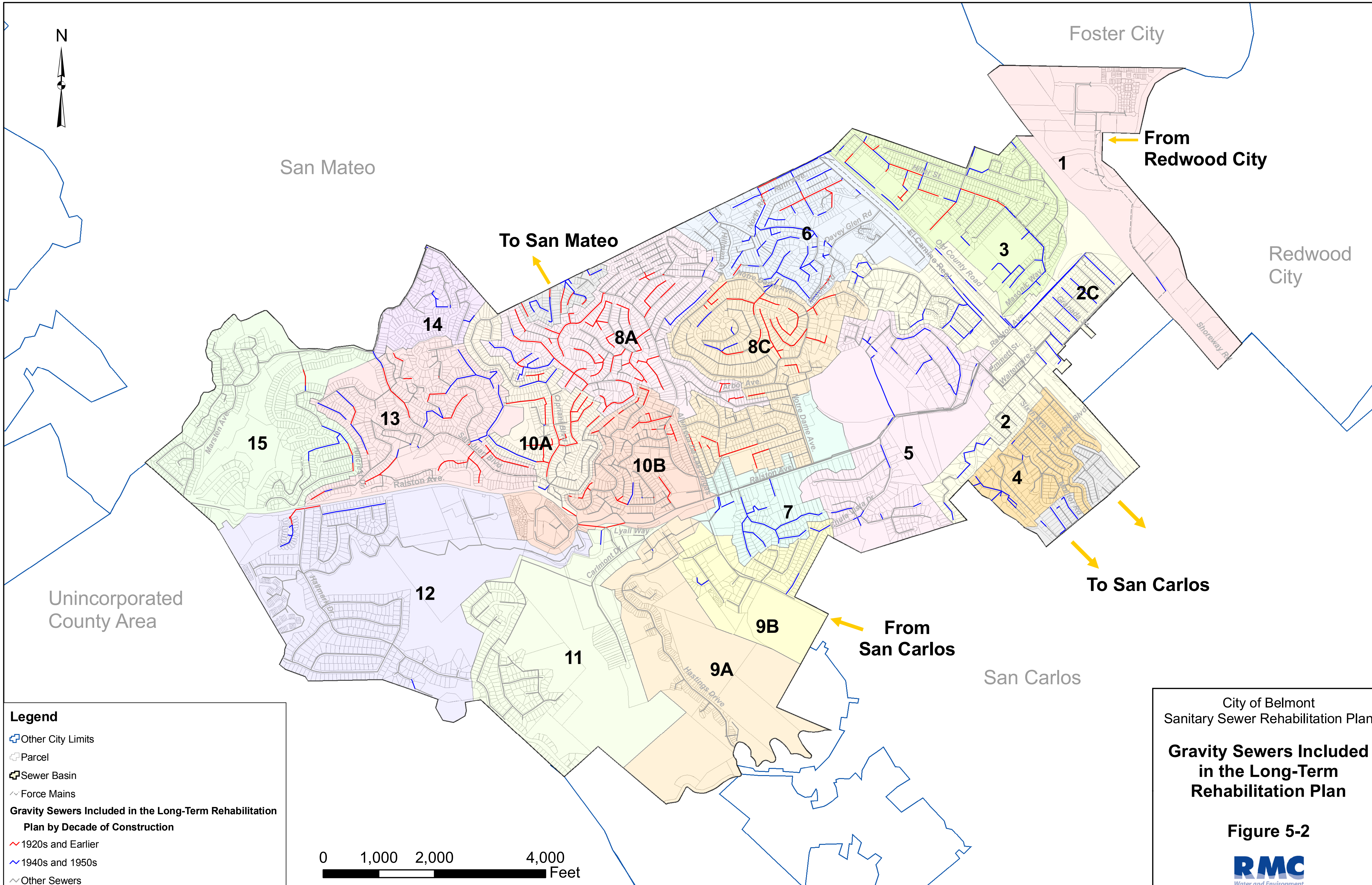
Gravity sewers in the long-term rehabilitation plan include the pipes constructed before 1960 that are not included in the City's near-term plan. As shown in Table 5-1, approximately 40,500 feet of the 168,500 feet of gravity sewers built before 1960 are included in City's near-term plan. The remaining 128,000 feet of non-rehabilitated gravity sewers constructed before 1960 are included in this long-term plan.

Figure 5-2 shows the gravity sewers included in the long-term rehabilitation plan. Table 5-3 indicates the length of pipe in each basin included in the plan. Figure 5-3 shows this information graphically, with basins ordered by length of sewers in the long-term plan that were built in the 1920s or earlier. Including the pipes in the City's near-term rehabilitation plan, as discussed in Section 5.1, the average rehabilitation rate of gravity sewers over the next 25 years would be approximately 8,300 feet per year. This rate of rehabilitation is consistent with the City's historical rehabilitation rate of about 8,000 feet per year over the past 16 years, as discussed in Section 2.3.

Table 5-3 Length of Gravity Sewers in Long-Term Rehabilitation Plan, by Basin

Basin	Total Length Constructed before 1960[a]	Pipes Included in Long-Term Rehabilitation Plan (not included in City's near-term plan)		
		Length Constructed before 1960	Length Constructed 1920s or Earlier[a]	% Constructed 1920s or Earlier[b]
01	310	310	-	0%
02	10,950	10,950	-	0%
02c	3,500	3,500	-	0%
03	11,290	11,290	3,680	33%
04	1,900	1,900	-	0%
05	6,060	6,060	-	0%
06	15,920	15,920	3,330	21%
07	6,040	5,490	-	0%
08a	25,100	19,300	15,830	82%
08c	20,710	12,270	10,550	86%
09a	370	40	-	0%
09b	6,460	1,180	-	0%
10a	12,720	9,540	7,430	78%
10b	9,230	4,590	4,170	91%
11	1,720	1,110	870	78%
12	5,500	2,770	800	29%
13	17,550	13,150	6,730	51%
14	2,170	1,030	-	0%
15	5,570	2,430	670	28%
SC	1,530	1,530	-	0%
SM	3,980	3,730	1,250	34%
Total	**168,580**	**128,090**	**55,290**	**43%**

a. Length in feet. Length rounded to nearest 10 ft.
b. Percent of pipe constructed before 1960 included in long-year plan.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Gravity Sewers Included in the Long-Term Rehabilitation Plan

Figure 5-2

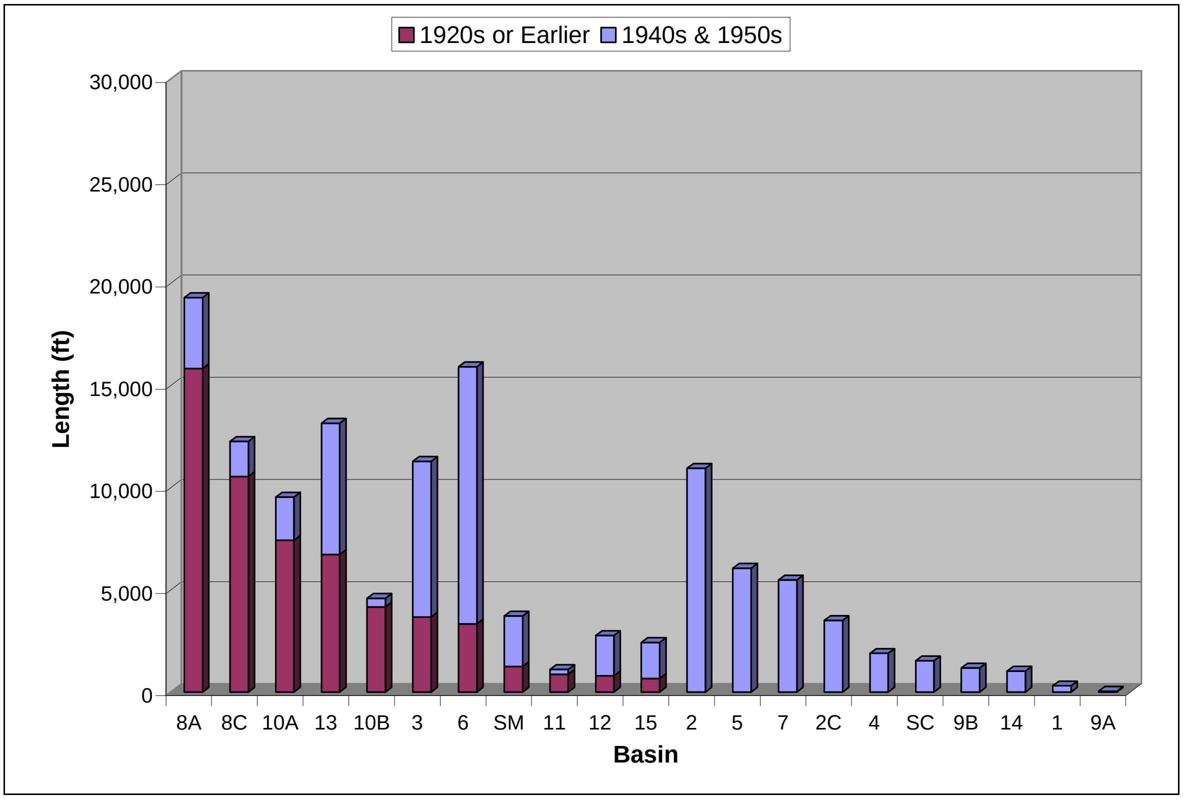


Figure 5-3 Length of Gravity Sewers Included in Long-Term Rehabilitation Plan, by Basin

Although the focus of this study was gravity sewer rehabilitation, the City also needs to plan for some level of force main rehabilitation. Most of the City's force mains are cast iron or ductile iron pipe (CIP or DIP), which can be prone to corrosion depending on site-specific soil conditions. Replacement or rehabilitation of these pipes should be based on periodic evaluations, including installation of electrolysis test stations at periodic points along the force main, as the useful life can vary widely. Therefore, the long-term plan for force main rehabilitation includes allowances for evaluation, spot repairs, and pipe replacement, as follows:

- Force main evaluation approximately every 10 years
- Annual allowance for spot repairs following evaluations
- Replacement of San Juan force main, Hastings force main, and a portion of Hiller force main over the 25-year planning period

As documented in Table 2-6, San Juan and Hastings force mains are the City's oldest metal force mains, both constructed in the 1970s. The 1,300 foot asbestos cement pipe (ACP) portion of Hiller force main was constructed in 1953 and is the City's oldest force main of any material.

The City should also consider pump station rehabilitation needs, based on pump station condition assessments. A comprehensive pump station assessment of most of the City's pump stations was completed in 1996 by Brian Kangas Foulk (BKF) Engineers, and the City is nearing the completion of the recommended improvements from that report. As noted in Section 5.1, the City has also identified additional pump station rehabilitation needs to be completed in the near-term. Although this study did not include any site-specific pump station evaluations, a long-term budget allowance for pump station rehabilitation is included based on the City's past and near-term planned rate of rehabilitation.

5.3 Estimated Rehabilitation Costs

Planning-level capital costs for gravity pipe and force main rehabilitation and replacement were estimated based on prior experience with similar projects in other Bay Area cities, as well as bid estimates from recent rehabilitation work in the City. These estimates are considered conceptual planning-level estimates and can be expected to range from +50 to -30 percent of the eventual cost of the project. This level of estimate is considered appropriate for planning and represents an "order of magnitude" cost estimate as defined by the Association of Cost Estimating Engineers.

The following sub-sections present the cost criteria used to estimate rehabilitation costs, as well as the total estimated costs for the near-term and long-term rehabilitation plans.

5.3.1 Cost Criteria

Table 5-4 presents the unit costs and additional factors used for estimating costs for gravity sewer rehabilitation. All costs are given in early 2007 dollars (ENR-CCI of approximately 9100 for San Francisco Bay Area). Unit costs are given in dollars per linear foot ($/lf). Note that pipe bursting and remove and replace costs for 6-inch diameter sewers allow for replacement with an 8-inch diameter pipe. Many cities no longer install 6-inch diameter sewers. Pipe lining costs include budget for spot repairs prior to lining and external reconnection of service laterals, which is recommended to improve the effectiveness of the rehabilitation work in addressing I/I. Note that some pipes with relatively few defects may require only spot repairs; therefore, a unit cost for rehabilitation by spot repair is also shown, based on two repairs for a typical 300-foot manhole-to-manhole pipe reach.

Table 5-5 presents the unit costs and additional factors used for estimating force main replacement costs.

As shown in Table 5-4 and in Table 5-5, a contingency of 25 percent above the "basic" construction cost subtotal has been included in the estimated costs to cover unknown factors or unidentified cost elements that can affect the ultimate cost. An additional markup of 25 percent has been applied to the cost estimates after contingencies to account for the technical services needed to implement the project, such as utility location research, engineering design, construction services inspection, contract administration, legal services, and other similar technical requirements.

The City currently does not rehabilitate or replace the lower laterals (typically the lateral within the public right-of-way, from the main sewer to the property line) in conjunction with main line rehabilitation work. However, as discussed in Section 3.3, rehabilitation or replacement of lower laterals could provide additional benefits towards reducing I/I. Therefore, as noted in Table 5-4, lower lateral replacement has been included as an optional cost, and costs for the rehabilitation plan are presented both with and without lower lateral replacement.

Table 5-4 Gravity Sewer Rehabilitation Cost Criteria

Pipe Diameter	Spot Repair[a] ($/lf)	Pipe Lining or Bursting ($/lf)	Remove and Replace ($/lf)
6	$25	$60	$185
8	$25	$60	$185
10	$25	$67	$195
12	$25	$74	$205
15	$25	$81	$215
18	$25	$96	$230
21	$25	$116	$250
		Steep/Narrow Factor	See note (b) below.
		Lower Lateral Replacement (optional)	$20/lf. See note (c) below.
		Miscellaneous[d]	15%
			(Unit Cost Subtotal)
		Traffic Control	5%
		Mobilization	10%
		Trench Shoring (applied to Remove and Replace only)	$10/lf
			(Construction Cost Subtotal)
		Construction Contingency	25%
			(Construction Cost Total)
		Technical Services Allowance	25%
			(Total Estimated Cost)

a. Spot repair unit costs assume approximately 2 spot repairs per 300 feet of pipe, based on City-estimated cost of $2,500 - $5,000 per repair.

b. Based on previous experience by the City, unit costs for Remove and Replace are 100% higher for Basins 8a, 8c, 10a, 10b, and 13, and 50% higher for Basins 4, 5, and 6 due to prevalence of steep, narrow areas.

c. For Rehabilitation Plan costs, two overall costs are presented. One with lower lateral replacement, and one without. Costs with lower lateral replacement assume a 25 ft lateral, with 1 lateral per 40 feet of main line sewer for 6, 8, and 10-inch diameter sewers; 1 lateral per 80 feet of sewer for 12 and 15-inch diameter sewers; and 1 lateral per 160 feet for 18-inch diameter sewer. 21-inch diameter pipes were assumed to have no lateral connections.

d. Miscellaneous costs include additional basic cost items such as manhole rehabilitation or replacement; site cleaning; reconnection of laterals to the main line; and flow control or bypass pumping.

Table 5-5 Force Main Replacement Cost Criteria

Force Main Diameter	Remove and Replace ($/lf)
6	$125
8	$145
10	$155
12	$165
Miscellaneous[a]	5%
	(Unit Cost Subtotal)
Traffic Control	5%
Mobilization	10%
Trench Shoring	$5/lf
	(Construction Cost Subtotal)
Construction Contingency	25%
	(Construction Cost Total)
Technical Services Allowance	25%
	(Total Estimated Cost)

a. Miscellaneous costs include additional basic cost items such as air release valves; site cleaning; flow control / tie-ins, pump station modifications.

5.3.2 Near-Term Gravity Sewer Rehabilitation Plan Estimated Costs

Estimated costs for the City's planned near-term rehabilitation plan presented in Section 5.1 are shown in Table 5-6. City staff anticipate that nearly all of this work will be conducted by either pipe lining or pipe bursting. Only about 2,700 feet of pipe in Basin 12 (at St. James and Waltham Cross) is expected to be replaced by open cut construction methods due to significant defects in the pipe.

Table 5-6 Estimated Capital Costs for City's Near-Term Rehabilitation Plan

Basin	Length (lf) of Rehabilitated Pipe	Cost without Lower Lateral Replacement[a]	Cost with Lower Lateral Replacement[a]
8a	10,330	$ 1,300,000	$ 1,600,000
8c	12,020	$ 1,500,000	$ 1,800,000
San Mateo	240	$ 30,000	$ 40,000
10a	4,220	$ 520,000	$ 630,000
10b	7,260	$ 900,000	$ 1,100,000
13	7,850	$ 970,000	$ 1,200,000
14	1,480	$ 180,000	$ 220,000
7	860	$ 120,000	$ 140,000
9a	3,410	$ 430,000	$ 510,000
9b	7,490	$ 940,000	$ 1,100,000
11	3,310	$ 410,000	$ 500,000
12	12,670	$ 2,300,000	$ 2,600,000
15	8,270	$ 1,000,000	$ 1,200,000
Total Near-Term	**79,410**	**$10,600,000**	**$12,600,000**

a. Estimated costs assume all pipe lining or pipe bursting, except for about 2,700 feet of anticipated remove and replace construction in basin 12.

5.3.3 Long-Term Gravity Sewer Rehabilitation Plan Estimated Costs

Table 5-7 presents costs for the long-term rehabilitation plan. These costs cover all pipes constructed before 1960 that have not already been rehabilitated and that were not included in the City's near-term plan. The portion of the costs for pipes built in the 1920s or earlier is also shown separately. Based on estimates provided by City staff, these costs assume 80 percent pipe lining or bursting, 10 percent remove and replace, and 10 percent spot repairs.

Table 5-7 Total Estimated Capital Cost for Long-Term Rehabilitation Plan

Basin	Total Length[a]	Cost[b] without Lower Laterals		Cost[b] with Lower Laterals	
		Total	1920s and Earlier	Total	1920s and Earlier
1	310	$ 45,000	$ -	$ 50,000	$ -
2	10,950	$ 1,800,000	$ -	$ 2,000,000	$ -
2C	3,500	$ 500,000	$ -	$ 590,000	$ -
3	11,290	$ 1,600,000	$ 540,000	$ 1,900,000	$ 630,000
4	1,900	$ 300,000	$ -	$ 360,000	$ -
5	6,060	$ 1,000,000	$ -	$ 1,200,000	$ -
6	15,920	$ 2,600,000	$ 540,000	$ 3,000,000	$ 620,000
7	5,490	$ 800,000	$ -	$ 930,000	$ -
8A	19,300	$ 3,500,000	$ 2,900,000	$ 4,000,000	$ 3,300,000
8C	12,270	$ 2,200,000	$ 1,900,000	$ 2,500,000	$ 2,200,000
9A	40	$ 6,000	$ -	$ 7,000	$ -
9B	1,180	$ 170,000	$ -	$ 200,000	$ -
10A	9,540	$ 1,700,000	$ 1,400,000	$ 2,000,000	$ 1,500,000
10B	4,590	$ 840,000	$ 760,000	$ 950,000	$ 860,000
11	1,110	$ 180,000	$ 150,000	$ 200,000	$ 160,000
12	2,770	$ 400,000	$ 120,000	$ 470,000	$ 130,000
13	13,150	$ 2,400,000	$ 1,200,000	$ 2,700,000	$ 1,400,000
14	1,030	$ 150,000	$ -	$ 170,000	$ -
15	2,430	$ 350,000	$ 100,000	$ 410,000	$ 110,000
San Carlos	1,530	$ 220,000	$ -	$ 260,000	$ -
San Mateo	3,730	$ 540,000	$ 180,000	$ 630,000	$ 210,000
Total	**128,090**	**$21,000,000**	**$ 9,800,000**	**$25,000,000**	**$11,000,000**

a. Length of pipe constructed before 1960, not included in City's near-term plan. Length rounded to nearest 10 ft.
b. Cost assumes 80% lining or bursting, 10% spot repair, and 10% remove and replace, based on City staff estimate.

5.3.4 Pump Station Rehabilitation Costs

Table 5-8 shows the City's estimated costs for planned pump station improvements.

Table 5-8 City's Estimated Costs for Near-Term Pump Station Improvements

Pump Station Improvements	Estimated Cost
El Camino and Ralston Ranch Upgrades	$500,000
Hastings Pump Station Rehabilitation	$500,000
Island Park #1 and Motel Improvements	$250,000
Hiller and North Road Emergency Generator Installation	$150,000
Hiller and North Road Control Panel Canopy Installation	$150,000
Total	**$ 1,600,000**

Since the City has completed or plans to complete many improvements in the near-term, long-term pump station expenditures are estimated at approximately $100,000 per year on average (starting after the near-term pump station improvements are completed).

5.3.5 Force Main Rehabilitation Costs

Table 5-9 summarizes the estimated force main replacement costs for the 25-year CIP, based on the cost criteria presented in Section 5.3.1.

Table 5-9 Estimated Force Main Replacement Costs for 25-Year CIP

Force Main	Description	Estimated Cost
Hiller	1,300 feet 10-inch ACP, 1953	$ 390,000
Hastings	2,200 feet 6-inch CIP, 1970s	$ 540,000
San Juan	5,000 feet 12-inch DIP, 1977	$1,600,000
	Total	**$2,500,000**

Additionally, near and long-term budgets include a $10,000 allowance for force main spot repairs. Force main evaluations are budgeted at $50,000 for force mains greater than about 2,000 feet in length and $25,000 for shorter force mains, for a total of approximately $300,000 to evaluate all of the City's force mains once. The long-term budget allows for force main evaluation twice during the 25-year planning period.

5.4 Rehabilitation CIP Estimated Costs and Phasing

Figure 5-4 shows the recommended Sanitary Sewer Rehabilitation Plan CIP. Table 5-10 summarizes the total estimated costs for the City's 25-year Rehabilitation CIP, based on the information presented in the previous sections. Costs are presented both with and without lower lateral replacement. The total estimated cost averages to $1.6 million annually without lower lateral replacement, or $1.8 million annually with lower lateral replacement.

Table 5-10 Estimated Costs for 25-year Rehabilitation CIP

Rehabilitation Item	Total
Gravity Sewer Rehabilitation	$ 32,100,000
Capacity Study	$ 150,000
Pump Stations	
Hastings Rehabilitation[a]	$ 500,000
Hiller & North Road Emergency Generators[a]	$ 150,000
Island Park & Motel Evaluation and Upgrades[a]	$ 250,000
Hiller & North Road Control Panel Canopy[a]	$ 150,000
El Camino & Ralston Ranch Upgrades[a]	$ 500,000
Allowance for Future PS Rehabilitation	$ 2,000,000
Force Mains	
Allowance for Force Main Evaluation	$ 600,000
Allowance for Force Main Spot Repair	$ 240,000
Allowance for Force Main Replacement[b]	$ 2,500,000
Total Estimated Cost	**$ 39,100,000**
Additional Cost for Lower Lateral Replacement in Conjunction with Gravity Sewer Rehabilitation	*$ 5,100,000*
Total Estimated Cost, incl. Lower Lateral Replacement	***$ 44,200,000***

a. Estimated costs provided by City
b. Budget for replacement of San Juan; Hastings; and 1,300 feet of Hiller force mains

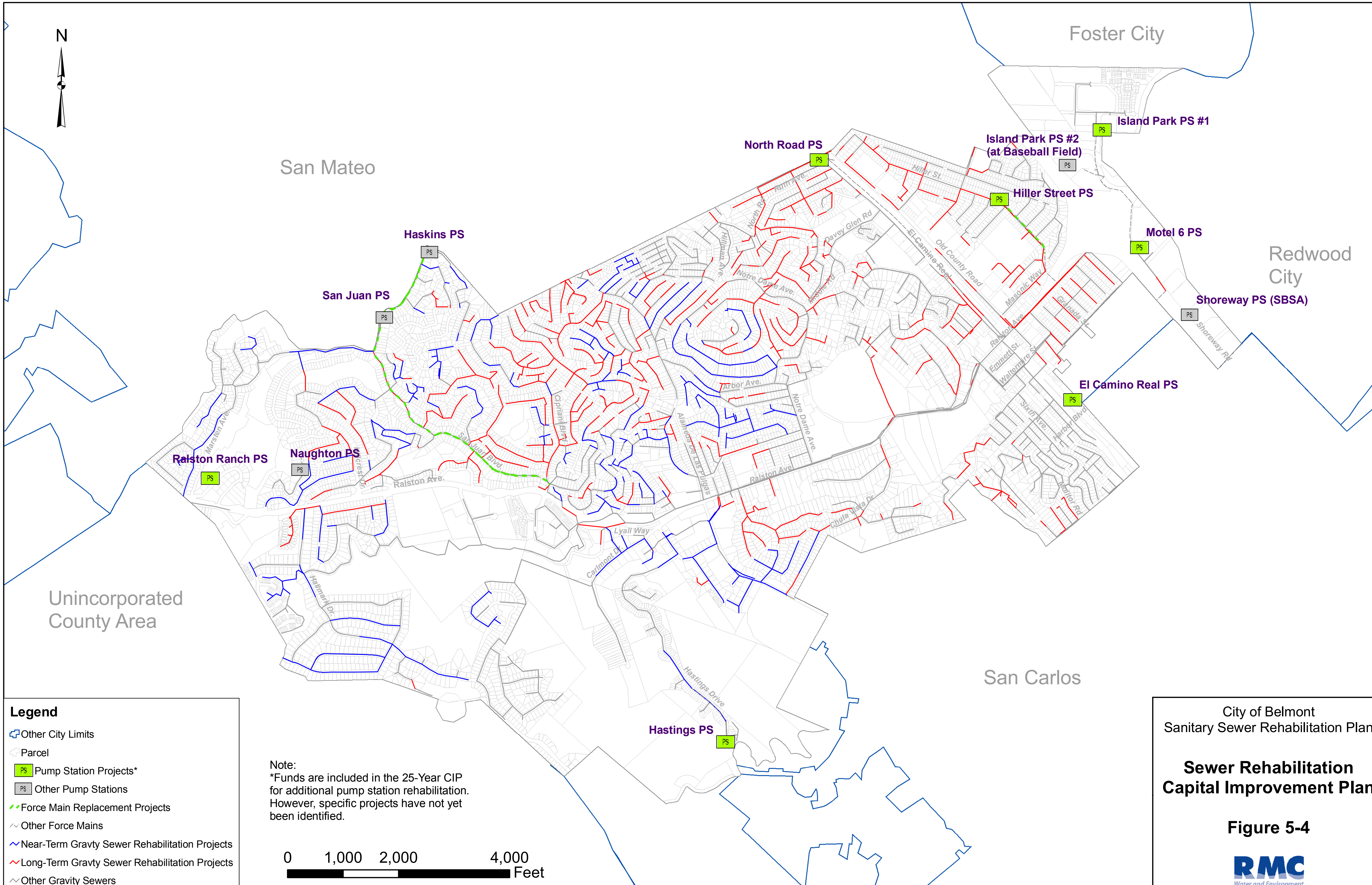
Table 5-11 summarizes the annual breakdown for the first 5-years of the CIP. This level of funding would allow for completion of over half of the City's planned near-term gravity sewer rehabilitation within 5 years.

Table 5-11 Estimated Cost by Year for 5-year Rehabilitation CIP

Cost Item	FY 2007/2008	FY 2008/2009	FY 2009/2010	FY 2010/2011	FY 2011/2012	Total
Gravity Sewer Rehabilitation	$ 800,000	$1,500,000	$1,300,000	$1,400,000	$1,400,000	$6,400,000
Hastings PS Rehabilitation[a]	$ 500,000	-	-	-	-	$ 500,000
Hiller and North Road PS Emergency Generators[a]	$ 150,000	-	-	-	-	$ 150,000
Island Park and Motel PS Evaluation and Improvements[a]	-	$ 50,000	$ 200,000	-	-	$ 250,000
Other PS Evaluations and Improvements[a]	-	-	-	$ 200,000	$ 200,000	$ 400,000
Force Main Evaluations[b]	-	$ 50,000	$ 50,000	$ 25,000	$ 25,000	$ 150,000
Force Main Annual Spot Repair Allowance	-	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 40,000
Capacity Study	$ 150,000	-	-	-	-	$ 150,000
Total	**$1,600,000**	**$1,610,000**	**$1,560,000**	**$1,635,000**	**$1,635,000**	**$8,040,000**
Additional Cost for Lower Lateral Replacement in Conjunction with Gravity Sewer Rehabilitation	$ 160,000	$ 300,000	$ 260,000	$ 280,000	$ 280,000	$1,300,000
Total incl. Lower Lateral Replacement	***$1,760,000***	***$1,910,000***	***$1,820,000***	***$1,915,000***	***$1,915,000***	***$9,340,000***

a. Estimated costs provided by City.
b. Budgeted for Haskins, Island Park, and Naughton force main evaluations in 2008/2009, 2009/2010, and 2010/2011, respectively.

In addition to the CIP requirements for rehabilitation of the City's sanitary sewer system presented in this report, the City will also need to participate in funding improvements to SBSA facilities, such as upgrade of the Shoreway Pump Station. Based on information provided by the City, the estimated cost of Belmont's share of these improvements is about $10 million.



City of Belmont
Sanitary Sewer Rehabilitation Plan

Sewer Rehabilitation Capital Improvement Plan

Figure 5-4

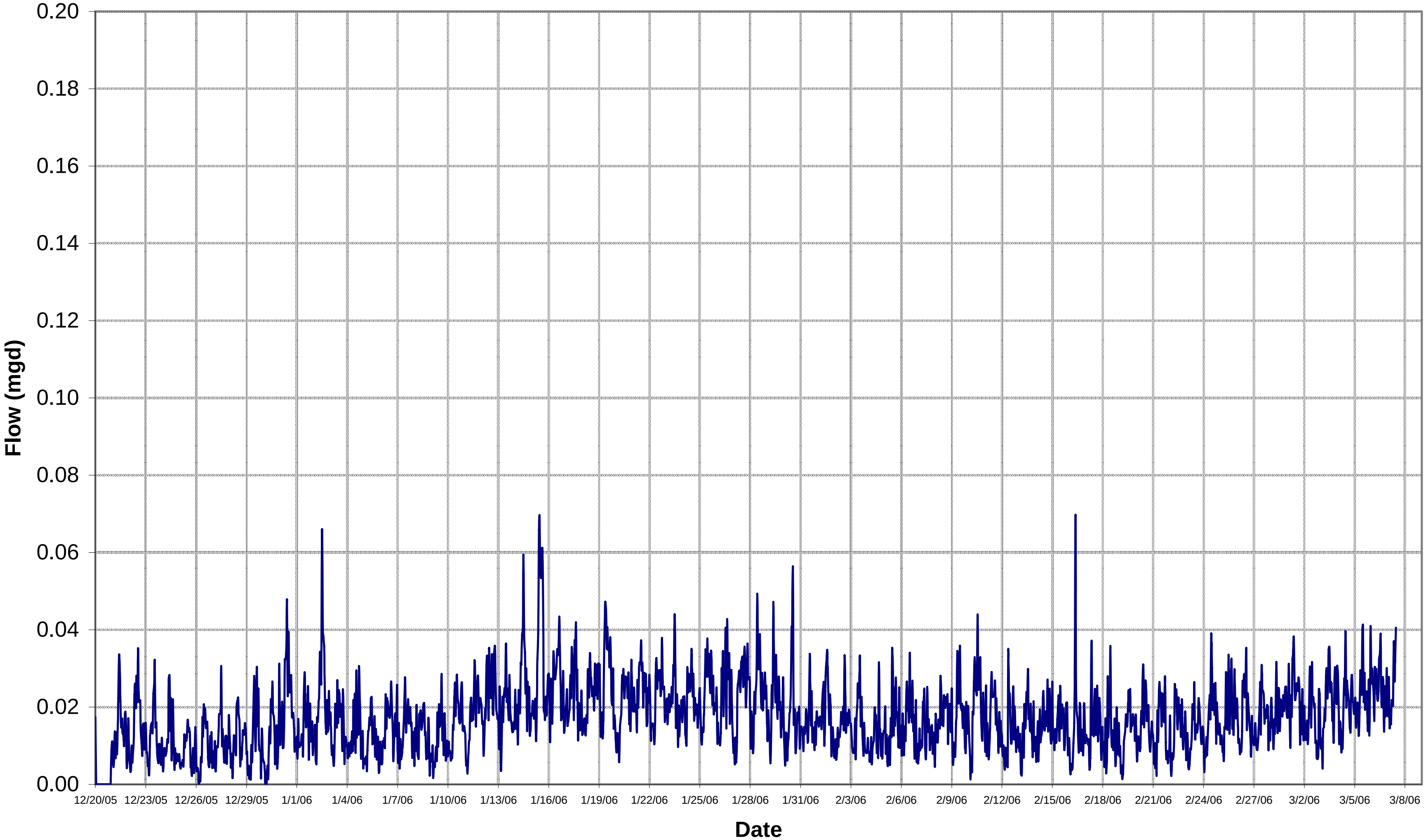
5.5 Recommendations for Assessing System Capacity

In addition to the proposed modifications to the City's sewer rehabilitation approach, it is also recommended that the City conduct a capacity assessment of its trunk sewer network. As noted in Chapter 3, the flow monitoring conducted for this study indicated that several areas of the system may not have adequate capacity to convey peak wet weather flows during large storm events. When rehabilitating or replacing sewer pipelines or pump stations due to structural condition or operational or maintenance needs, the potential need to also increase the capacity of the facilities should be considered, particularly for 8-inch and larger lines and larger pump stations that comprise the system's trunk sewer network. Work conducted for this study, including the system-wide flow monitoring program and updating of the City's asset inventory database and GIS to include rim and invert elevations for over 60 percent of the 8-inch and larger pipes, has provided much of the data needed to evaluate system capacity. The City should therefore conduct a capacity assessment, utilizing a hydraulic model calibrated to flow monitoring data, to identify areas with potential capacity deficiencies and needed capacity improvements. These capacity improvements, if necessary, should then be included in the sewer system CIP.

As shown in Table 5-11, an allowance of $150,000 for a system capacity study has been included in the proposed CIP for fiscal year 2007/2008. This project would allow the City to meet the August 2008 deadline for conducting a capacity assessment required as part of its Sewer System Management Plan.

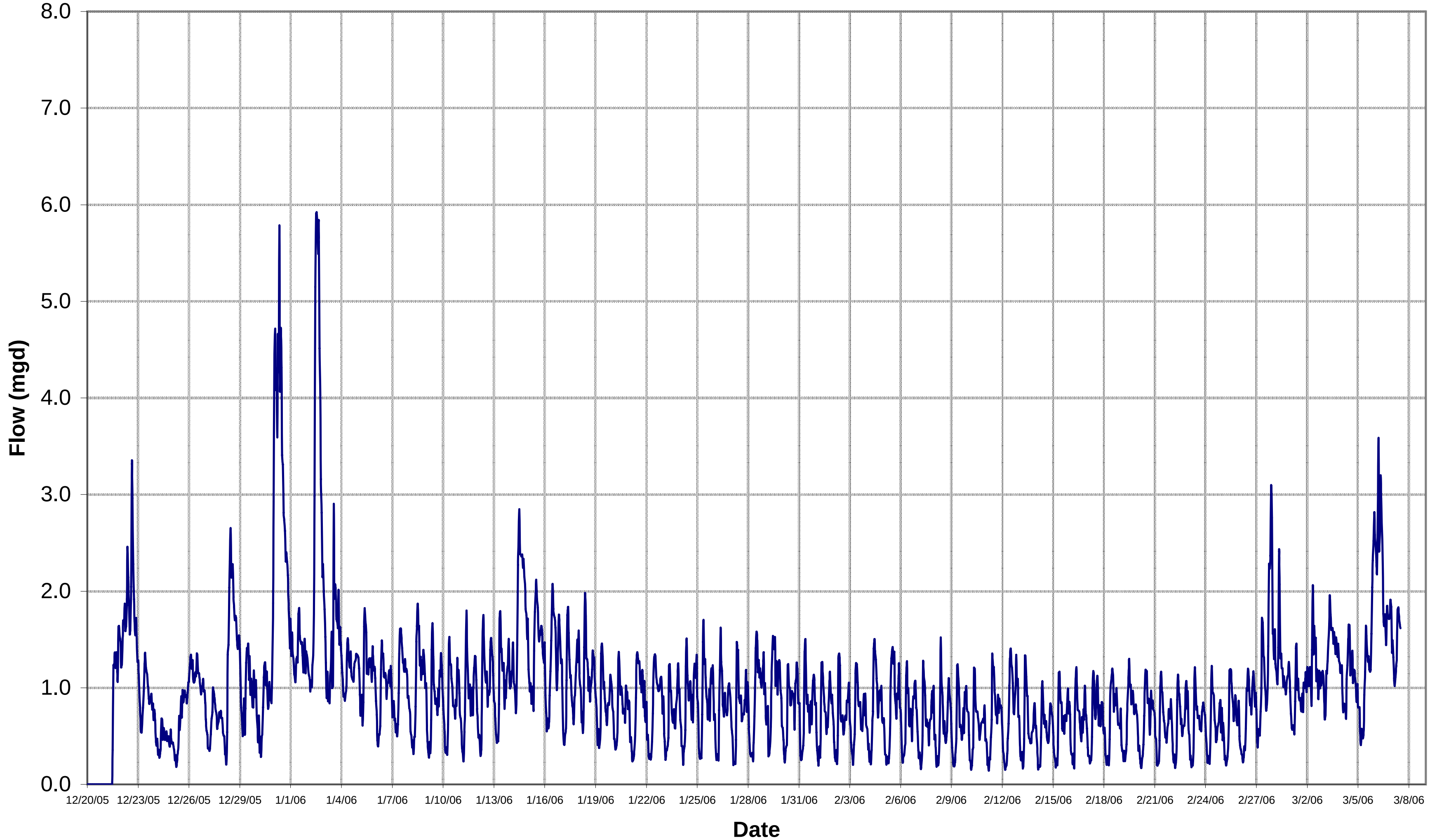
Appendix A - Flow Monitoring Charts

City of Belmont
Sanitary Sewer Flow Monitoring, Site 1



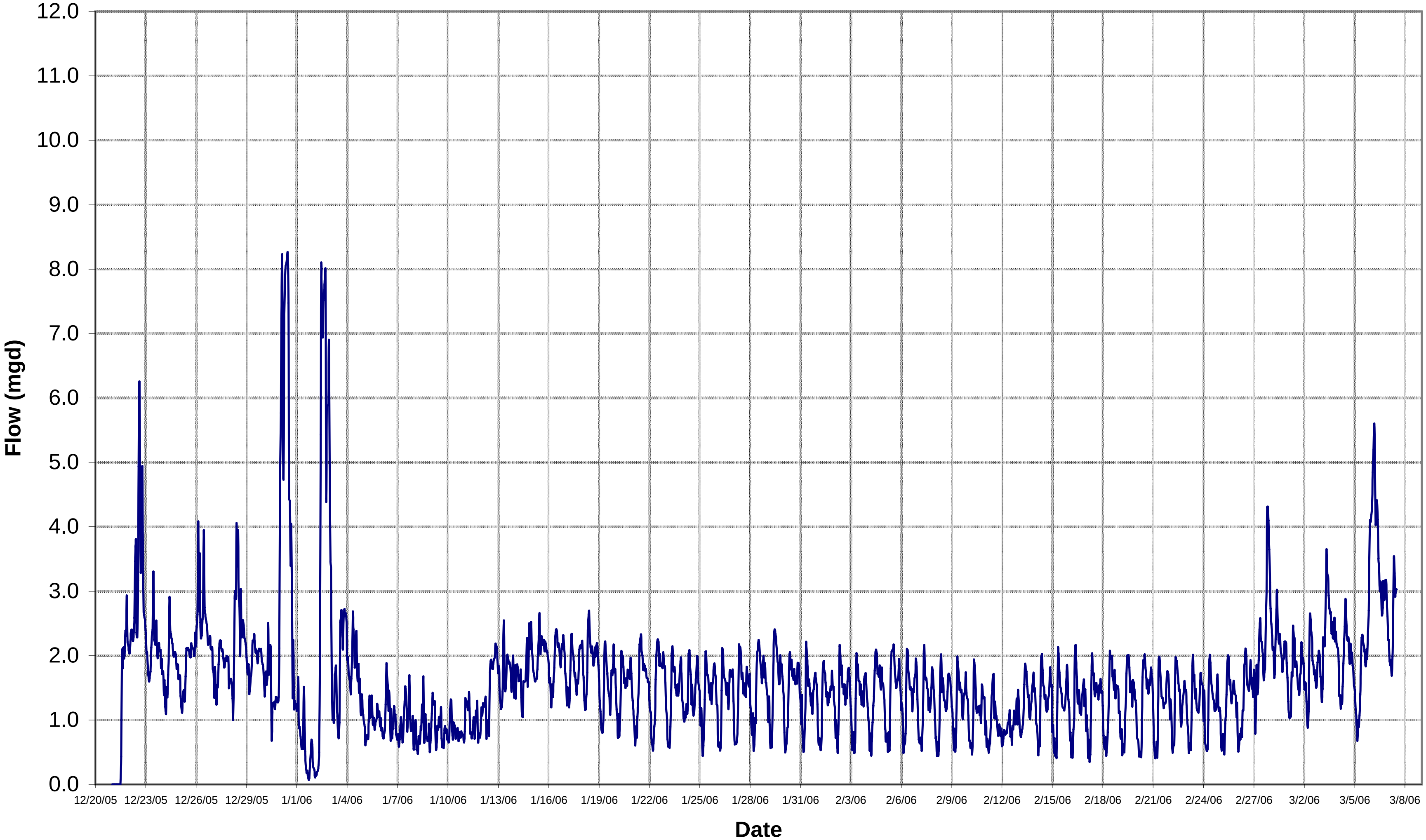
Site 1 010307.xls, Flow

City of Belmont
Sanitary Sewer Flow Monitoring, Site 2A

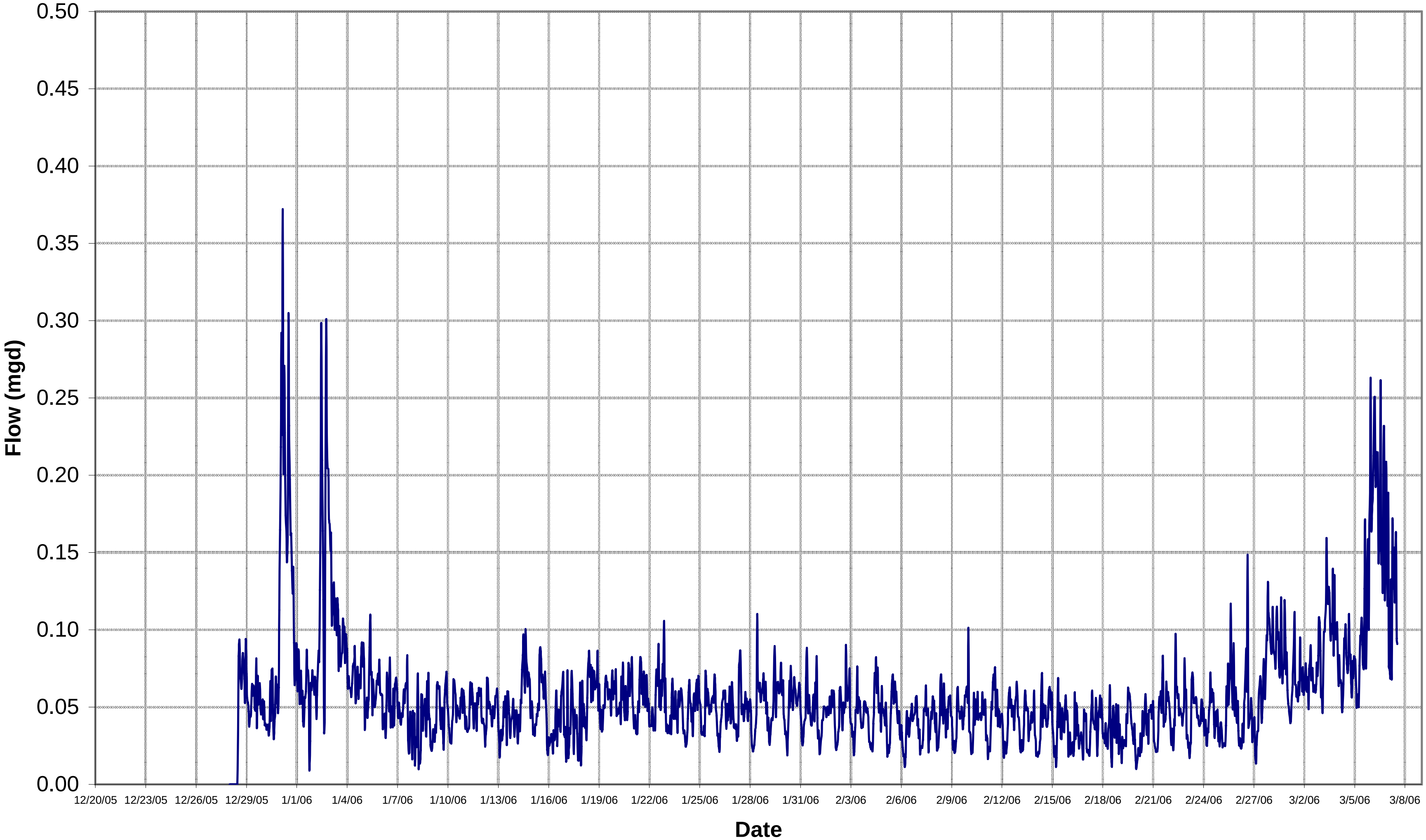


Site 2A Hourly 010307.xls, Flow

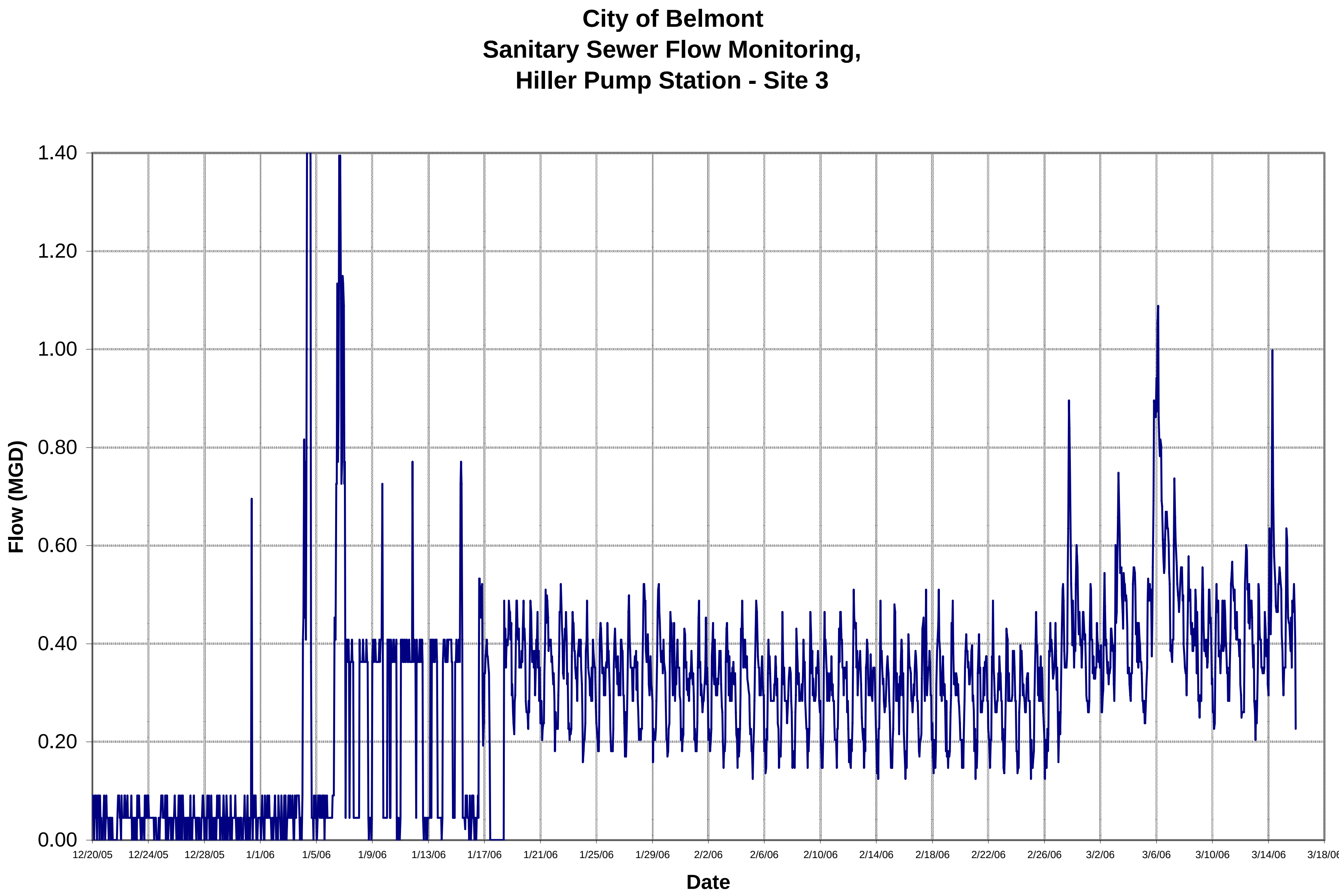
City of Belmont
Sanitary Sewer Flow Monitoring, Site 2B



City of Belmont
Sanitary Sewer Flow Monitoring, Site 2C



Site 2C Hourly 010307.xls, Flow



City of Belmont
Sanitary Sewer Flow Monitoring,
Hiller Pump Station - Site 3
Flow (MGD)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12/20/05
12/24/05
12/28/05
1/1/06
1/5/06
1/9/06
1/13/06
1/17/06
1/21/06
1/25/06
1/29/06
2/2/06
2/6/06
2/10/06
2/14/06
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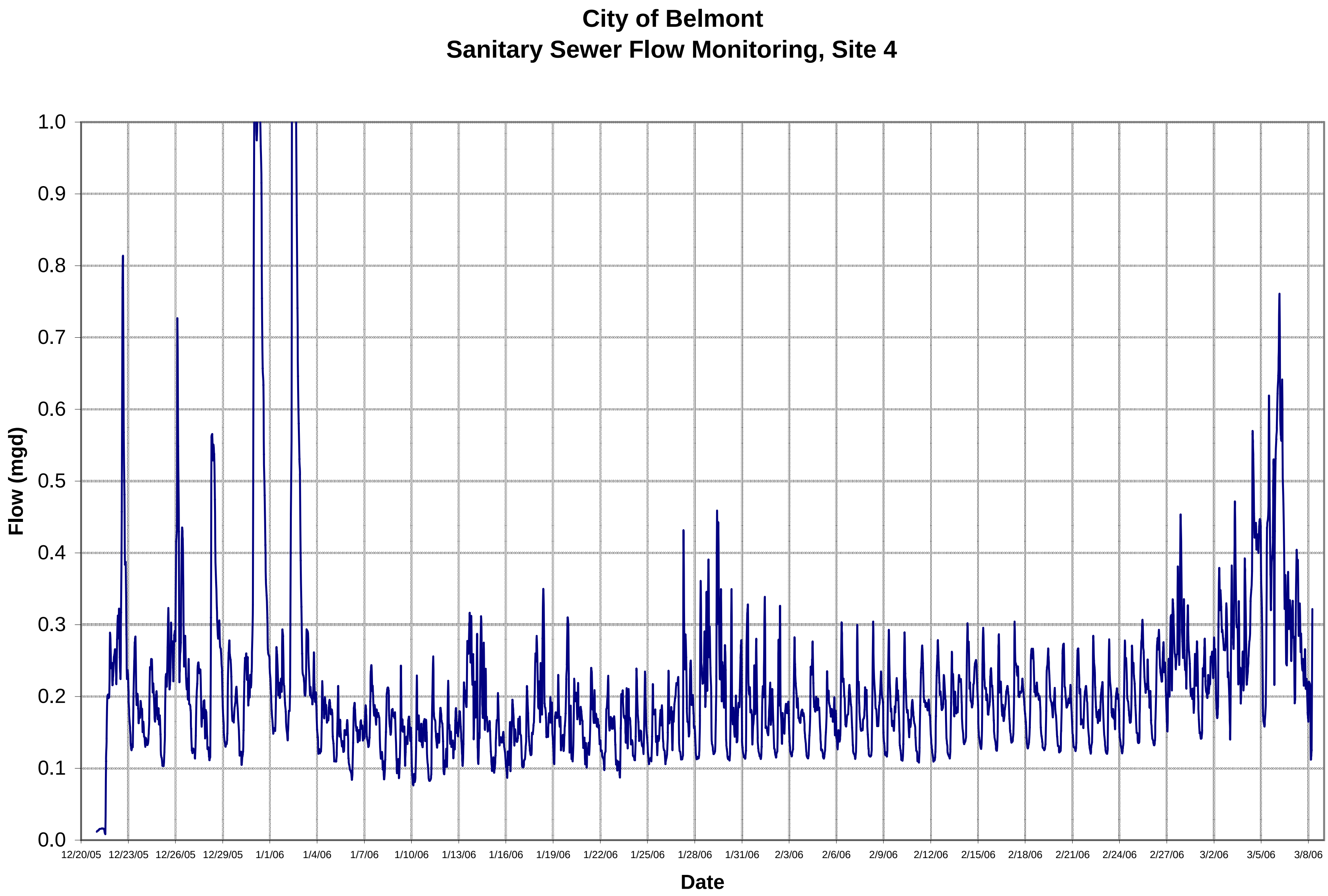
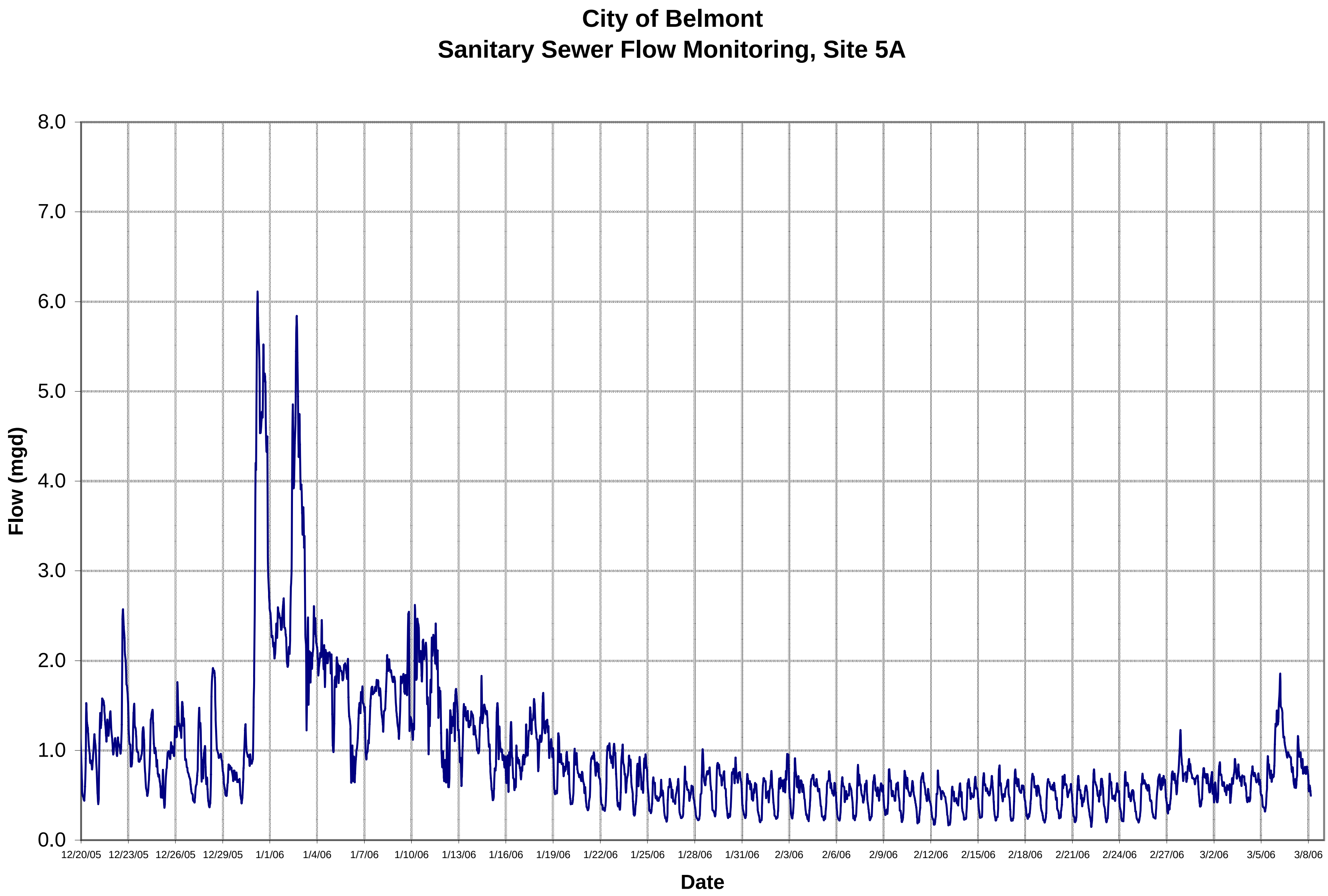
3/14/06
3/18/06
Date

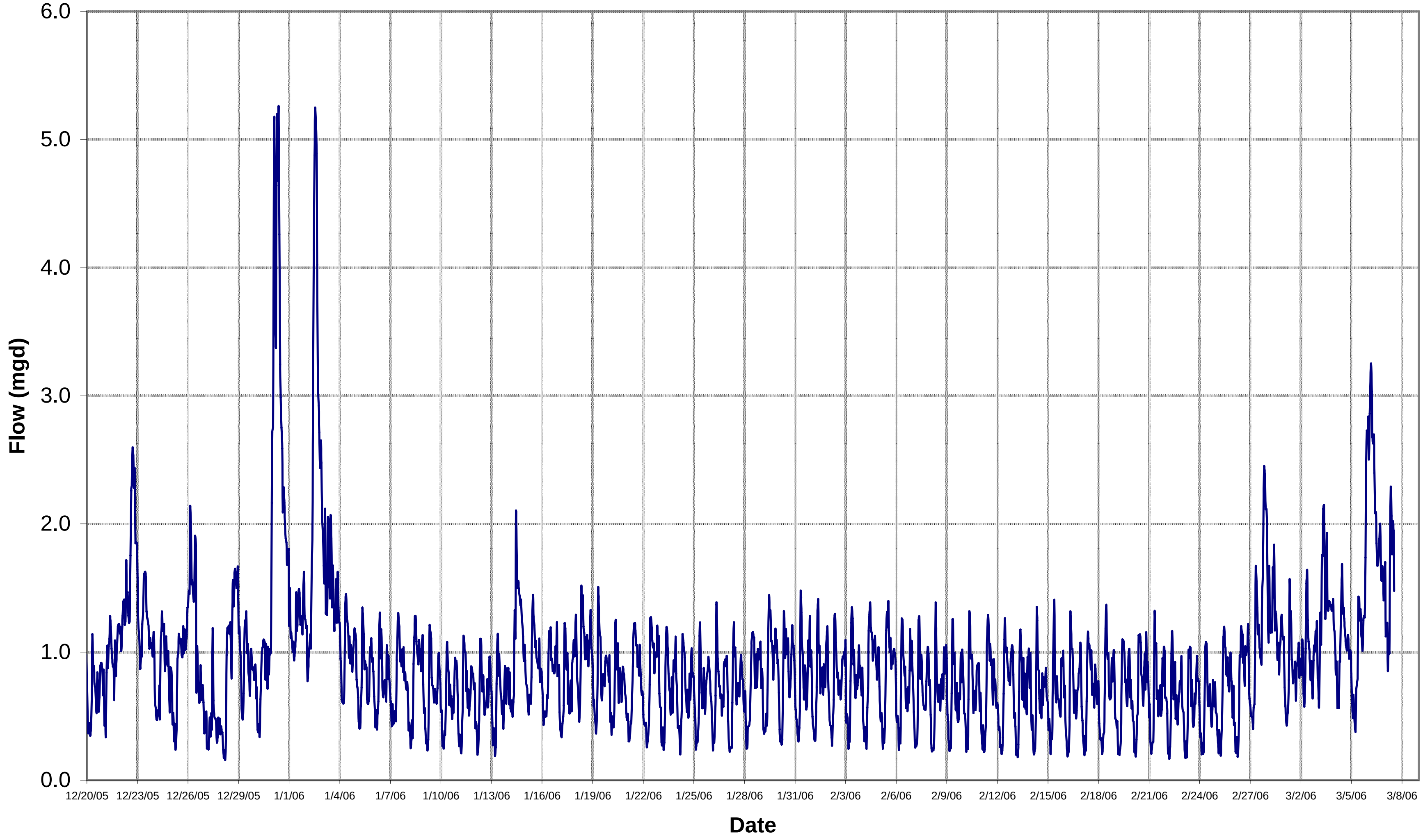


Site 4 Hourly 010307.xls, Flow

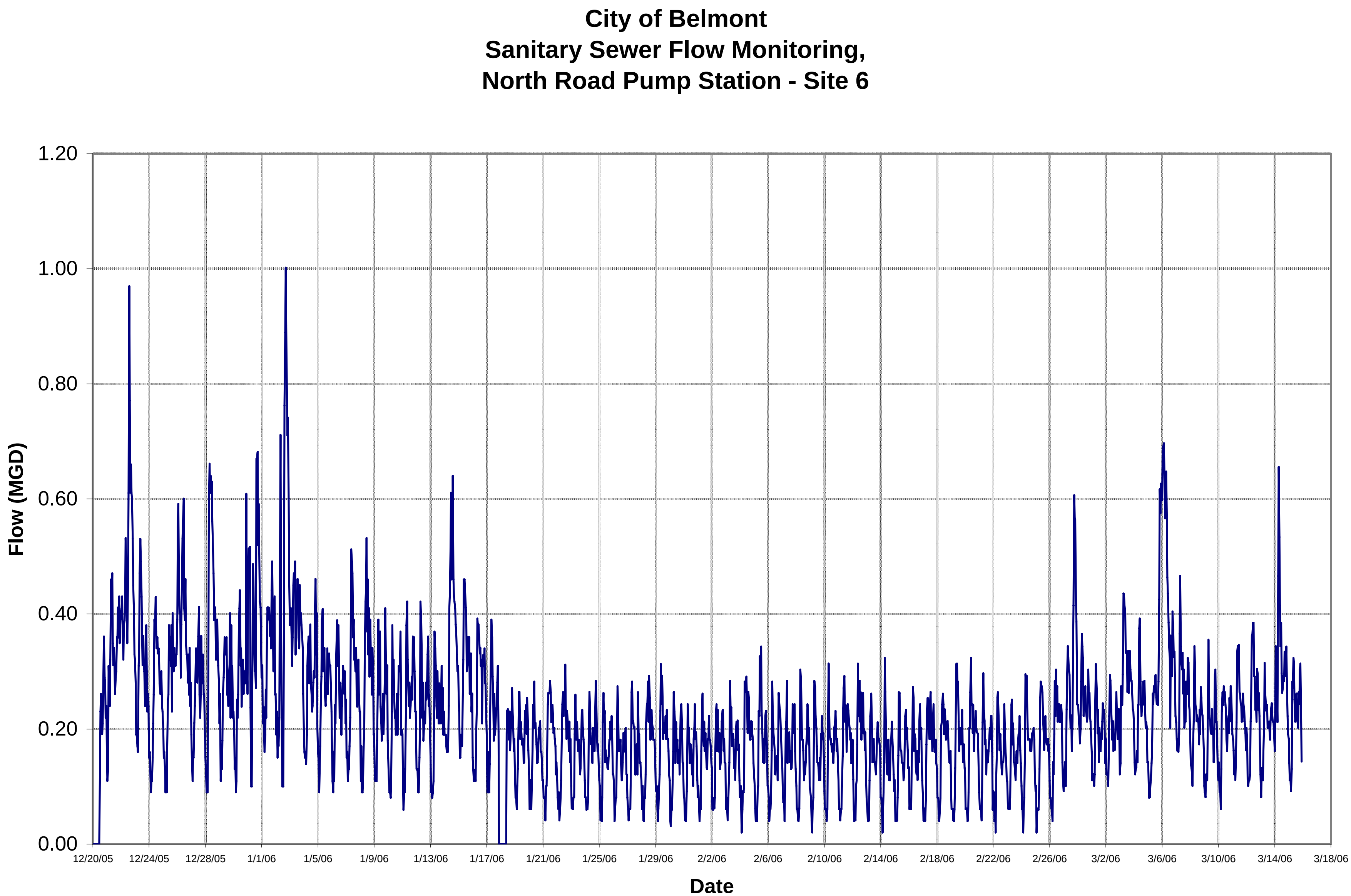


Site 5A hourly 010307.xls, Flow

City of Belmont
Sanitary Sewer Flow Monitoring, Site 5B

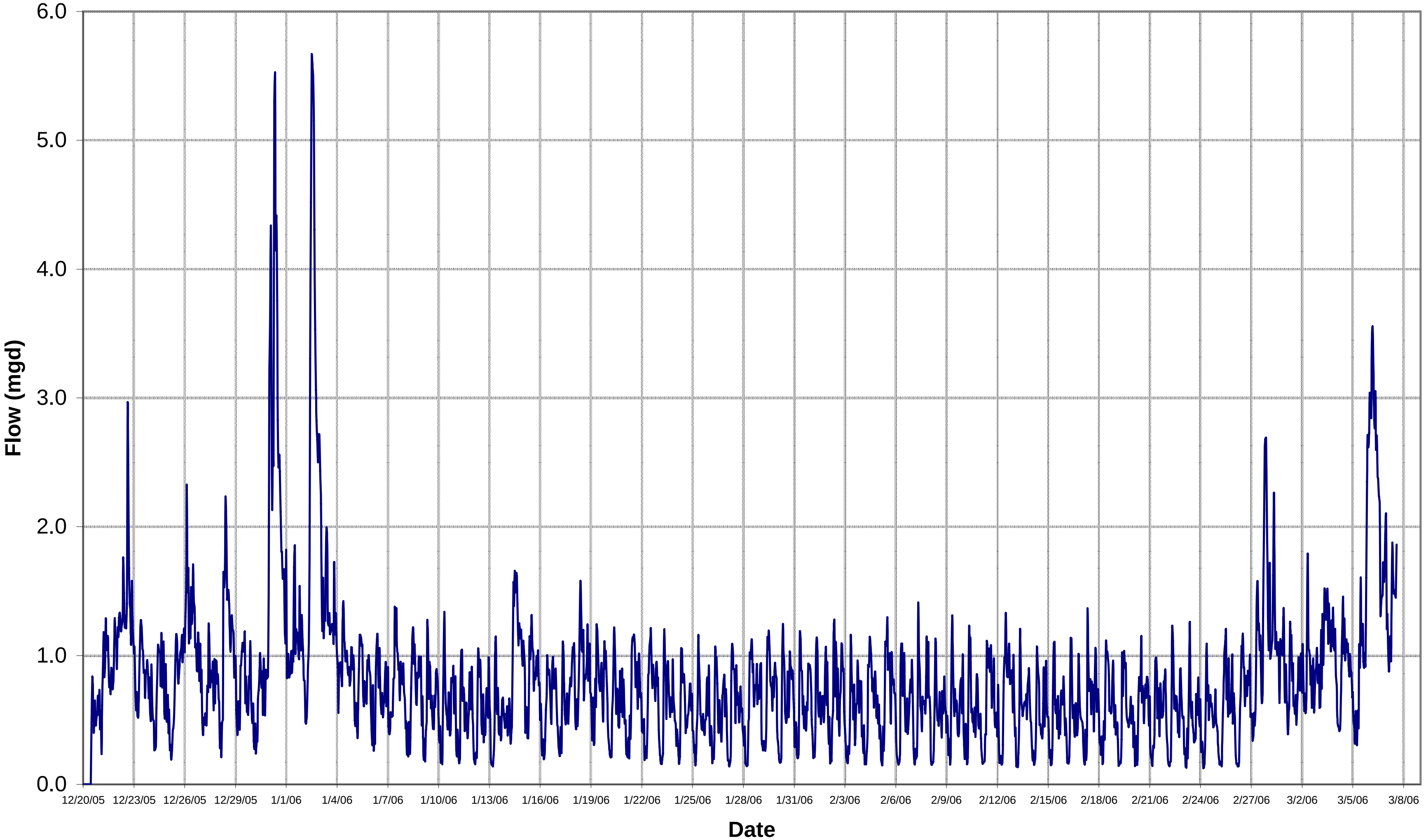


Site 5B hourly 010307.xls, Flow



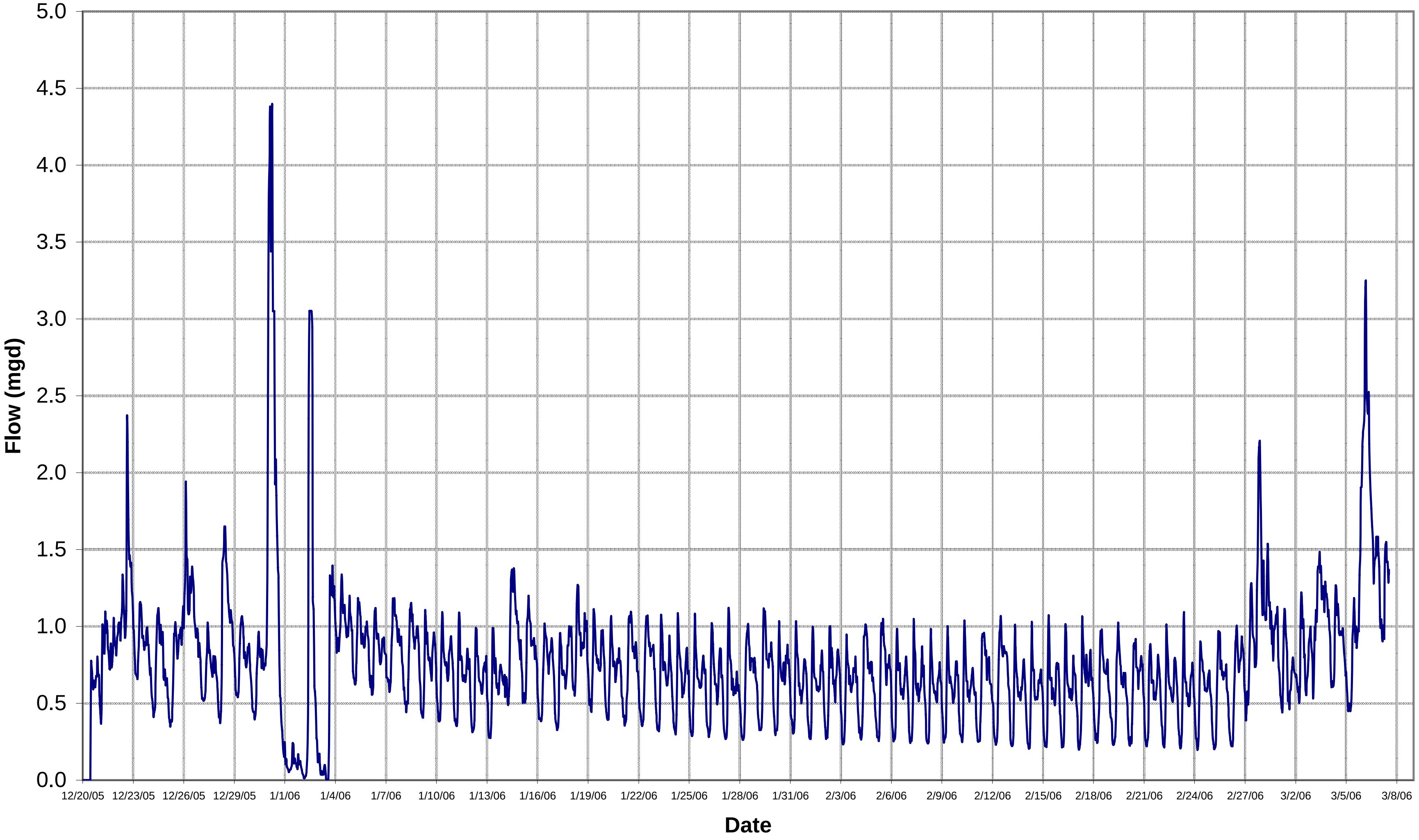
NORTH1 Pump 012507.xls, Flow vs. Time7

City of Belmont
Sanitary Sewer Flow Monitoring, Site 7A

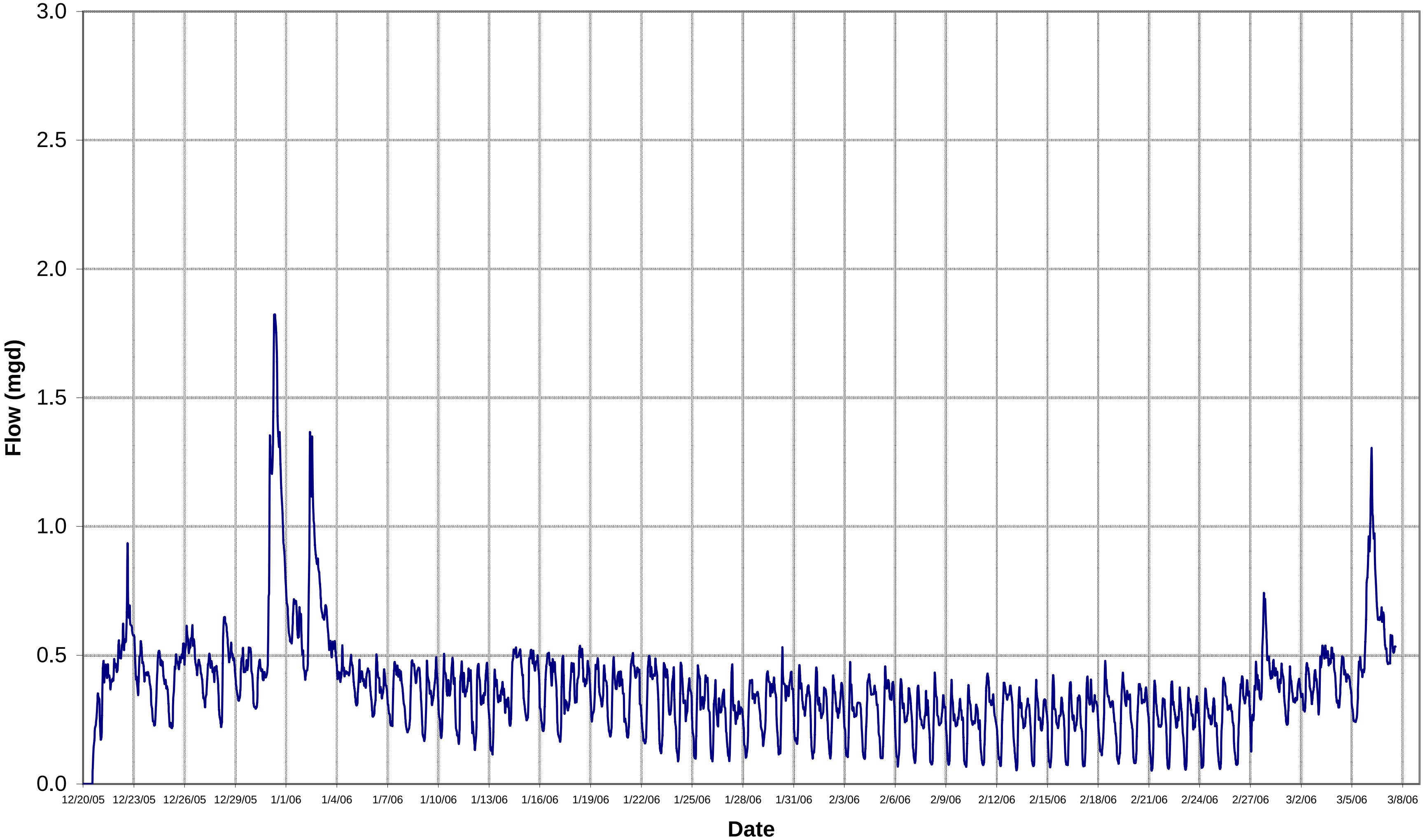


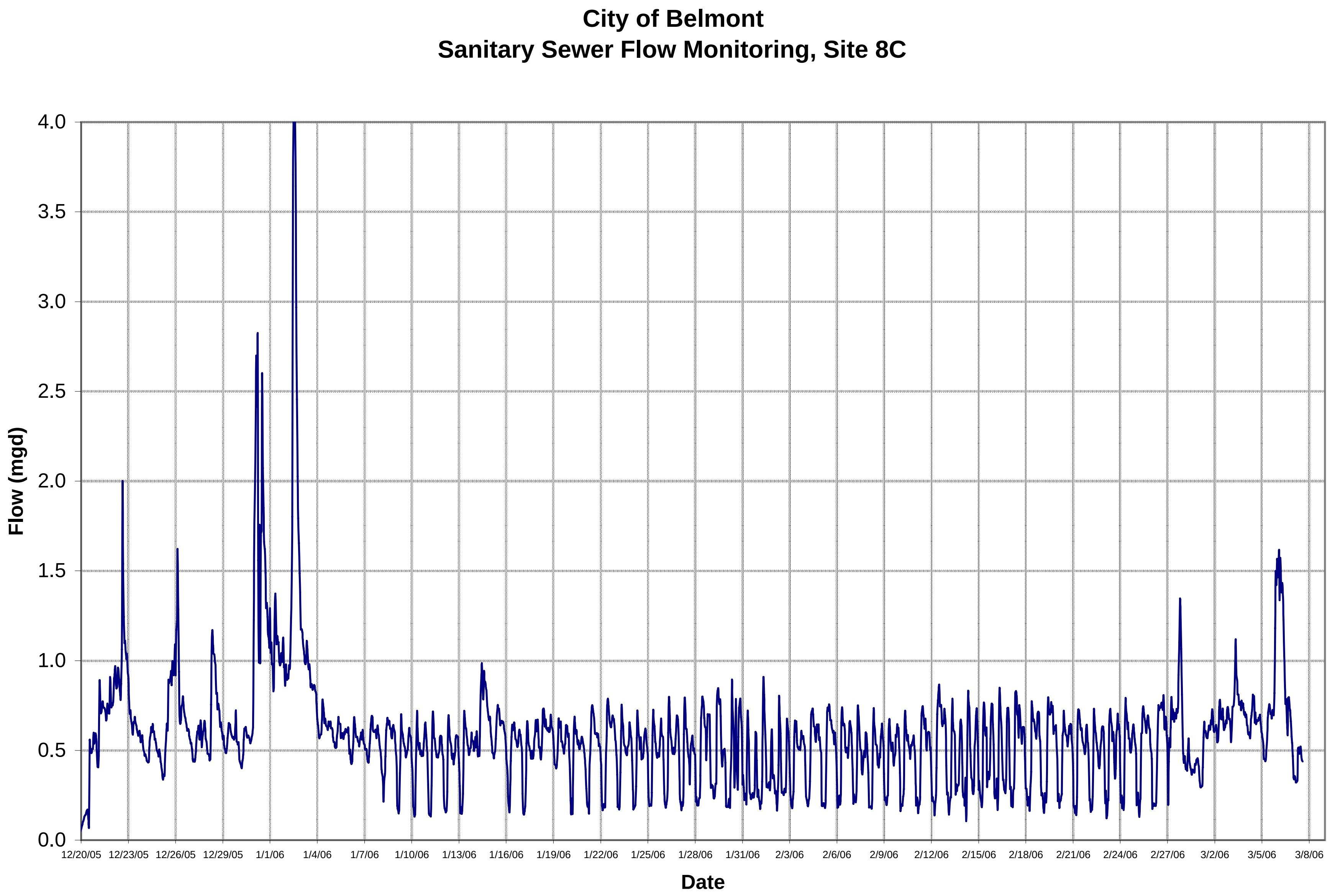
Site 7A Hourly 010307.xls, Flow

City of Belmont
Sanitary Sewer Flow Monitoring, Site 7B

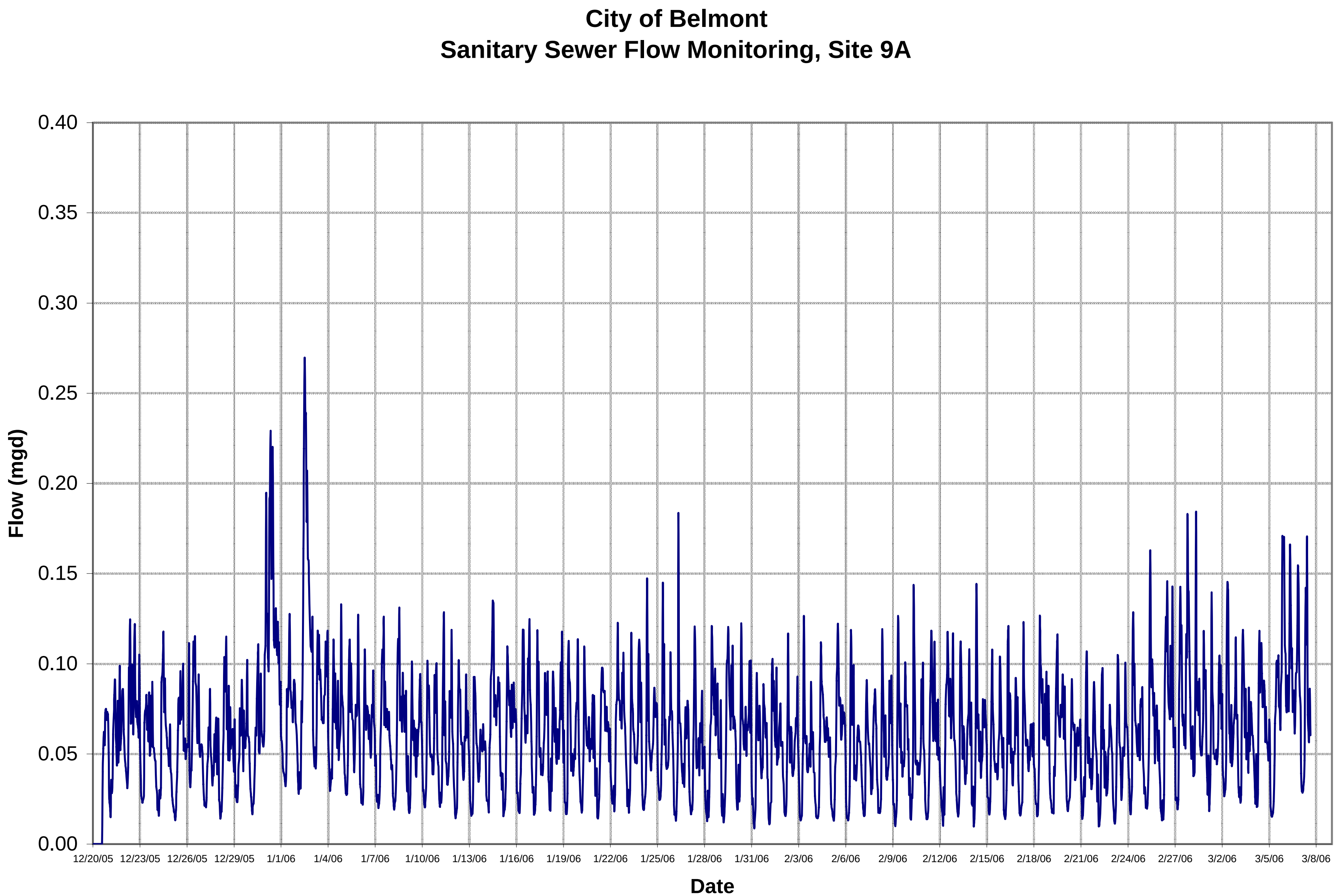


City of Belmont
Sanitary Sewer Flow Monitoring, Site 8A



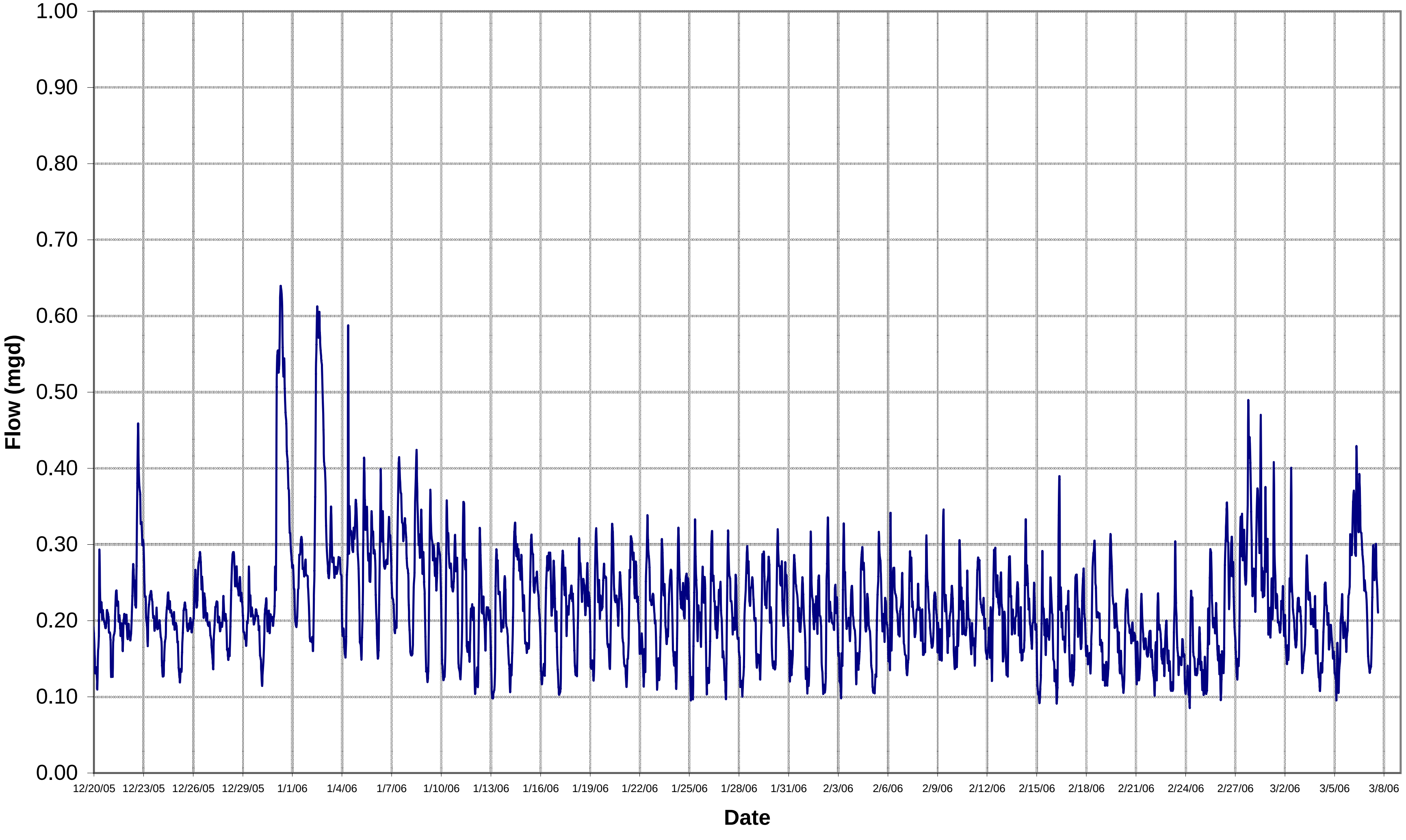


Site 8C hourly 010307.xls, Flow

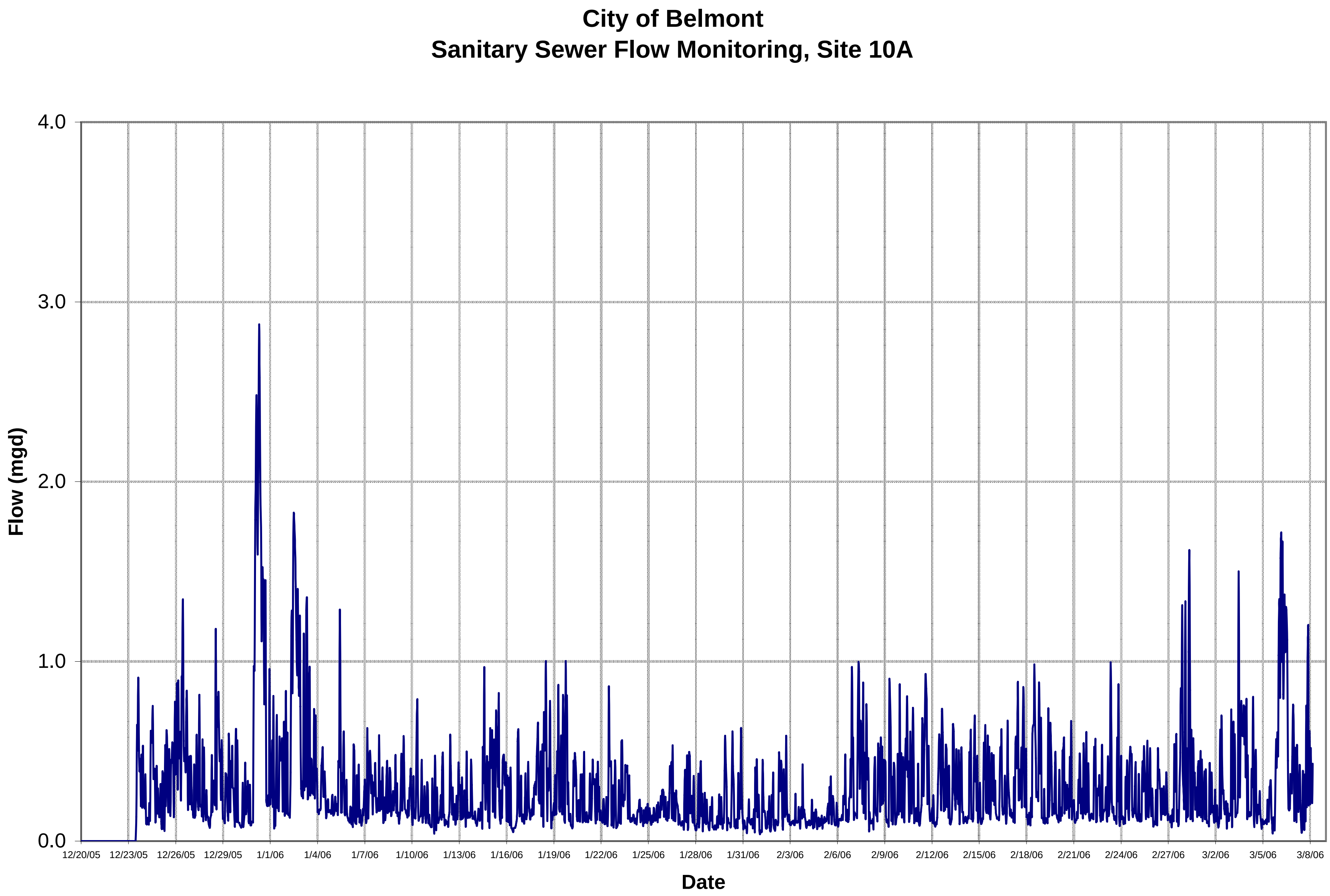


Site 9A hourly 010307.xls, Flow

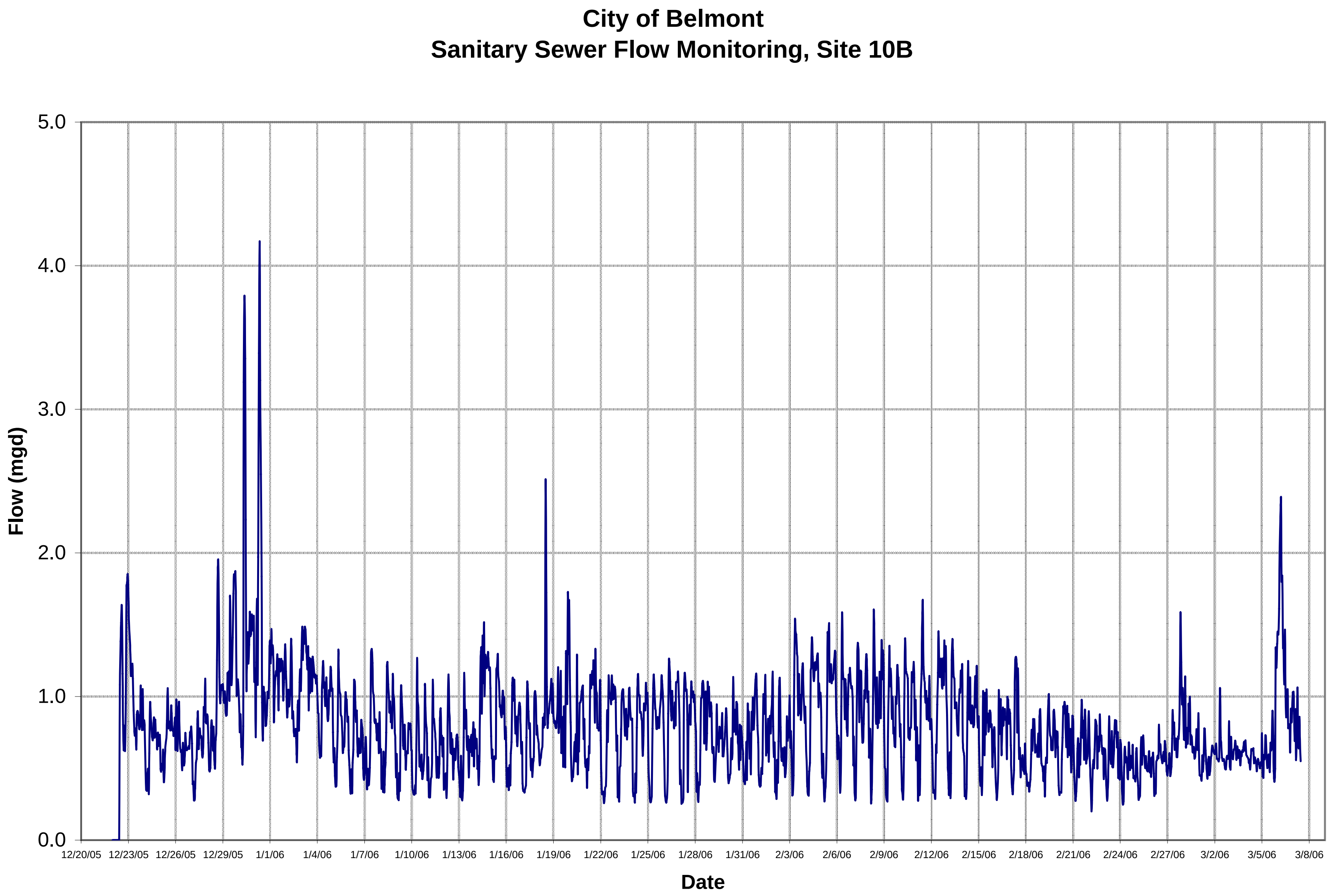
City of Belmont
Sanitary Sewer Flow Monitoring, Site 9B



Site 9B hourly 010307.xls, Flow

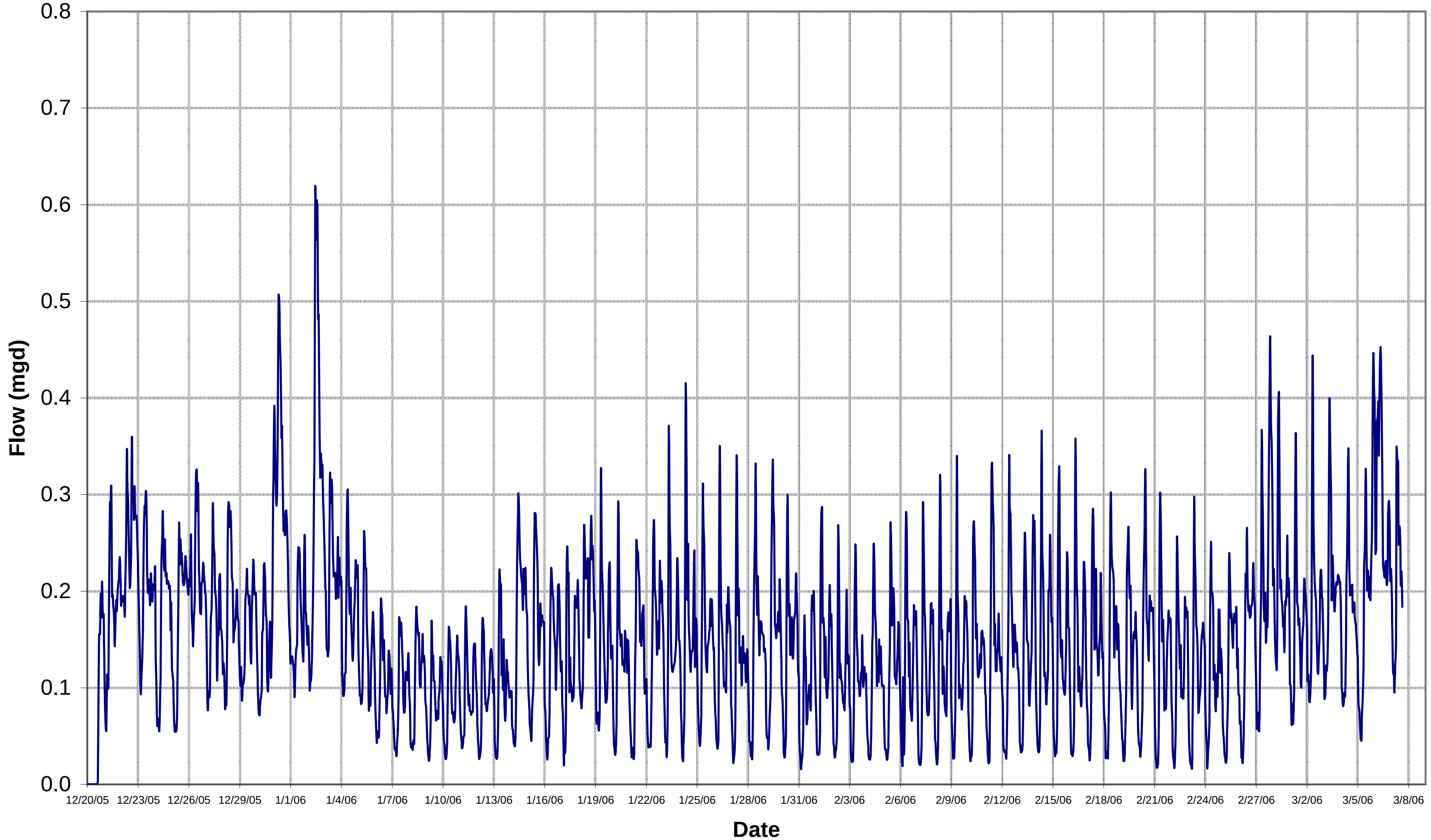


Site 10A hourly 010307.xls, Flow

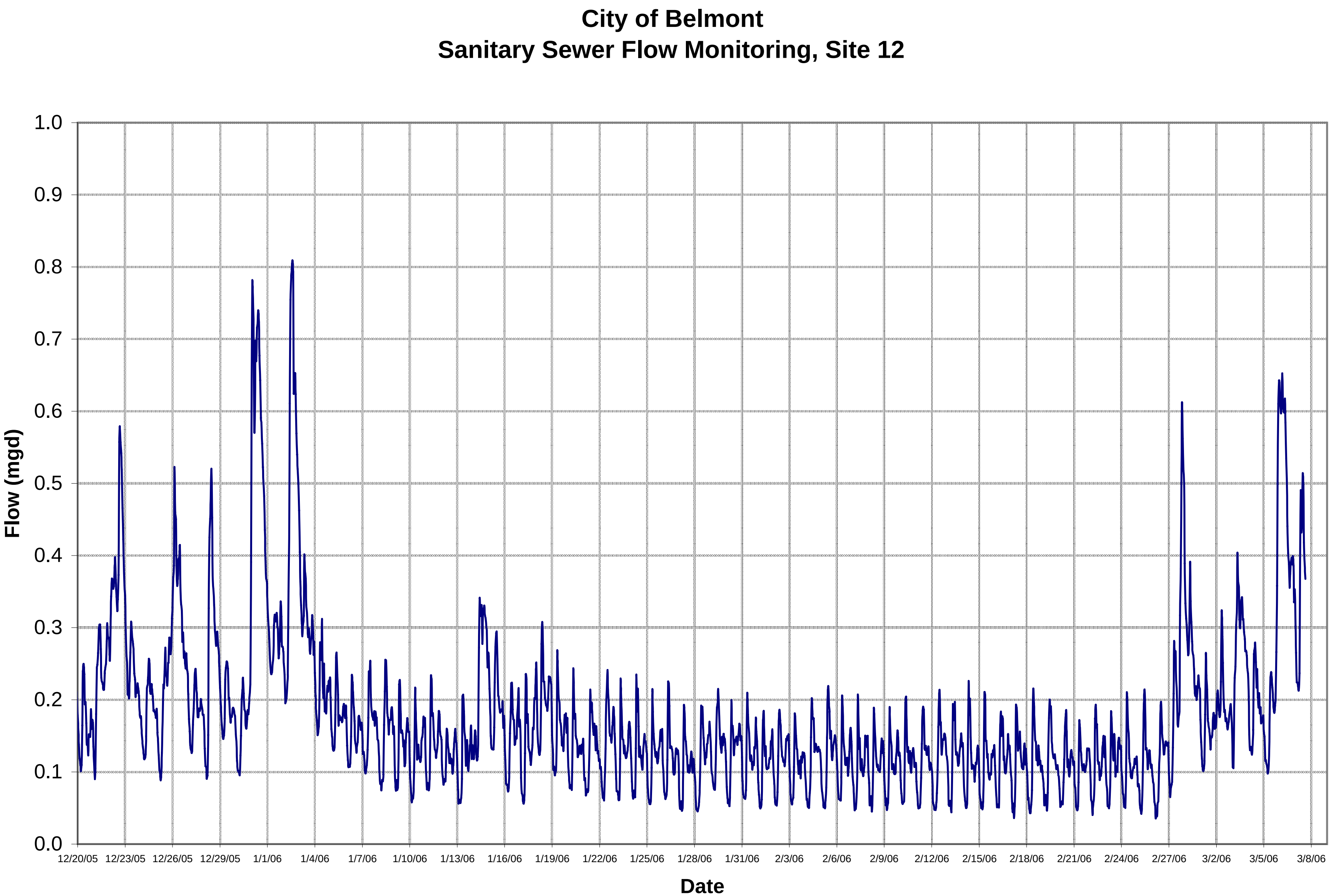


Site 10B hourly 012507.xls, Flow

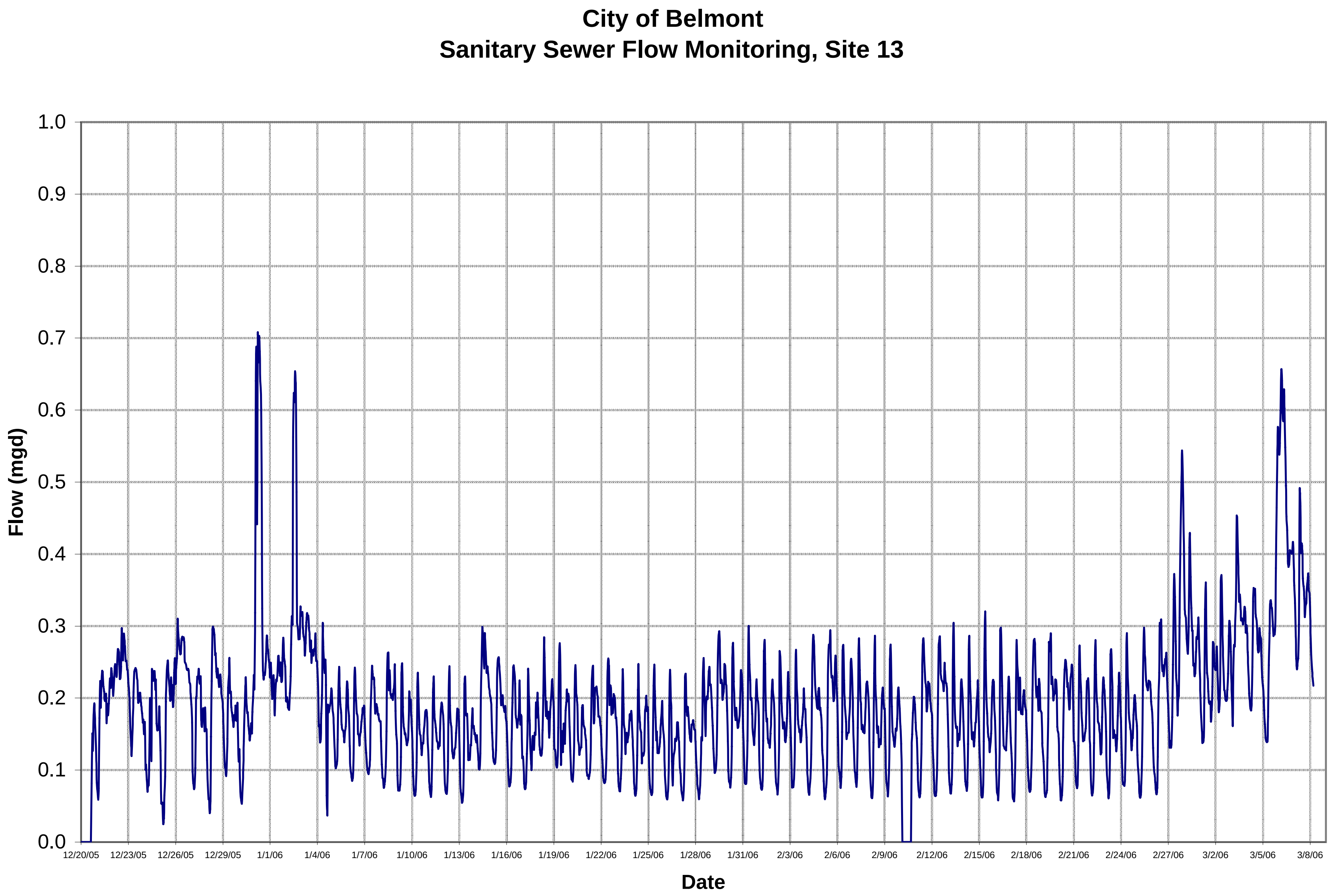
City of Belmont
Sanitary Sewer Flow Monitoring, Site 11



Site 11 Hourly 010307.xls, Flow

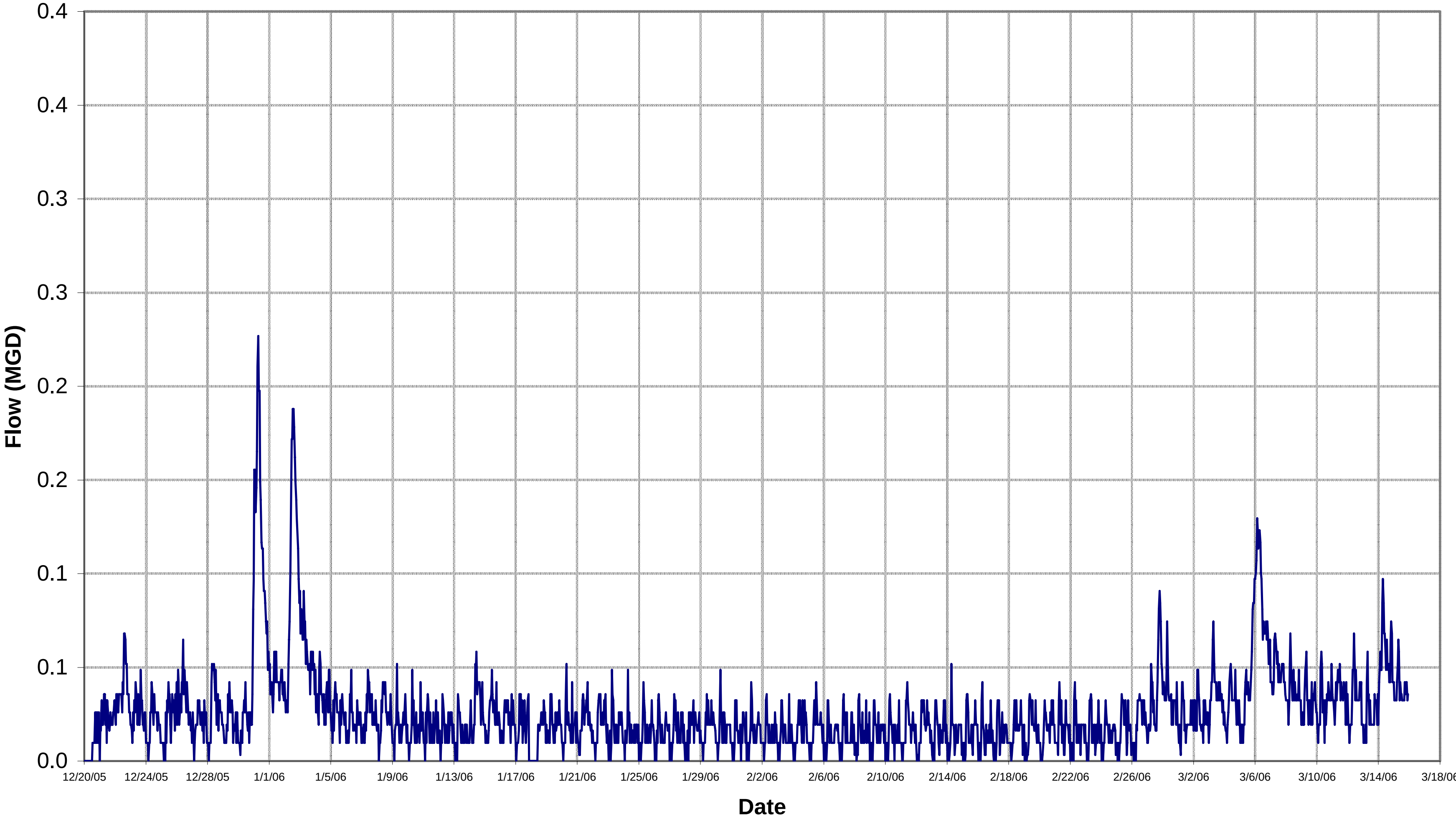


Site 12 hourly 010307.xls, Flow

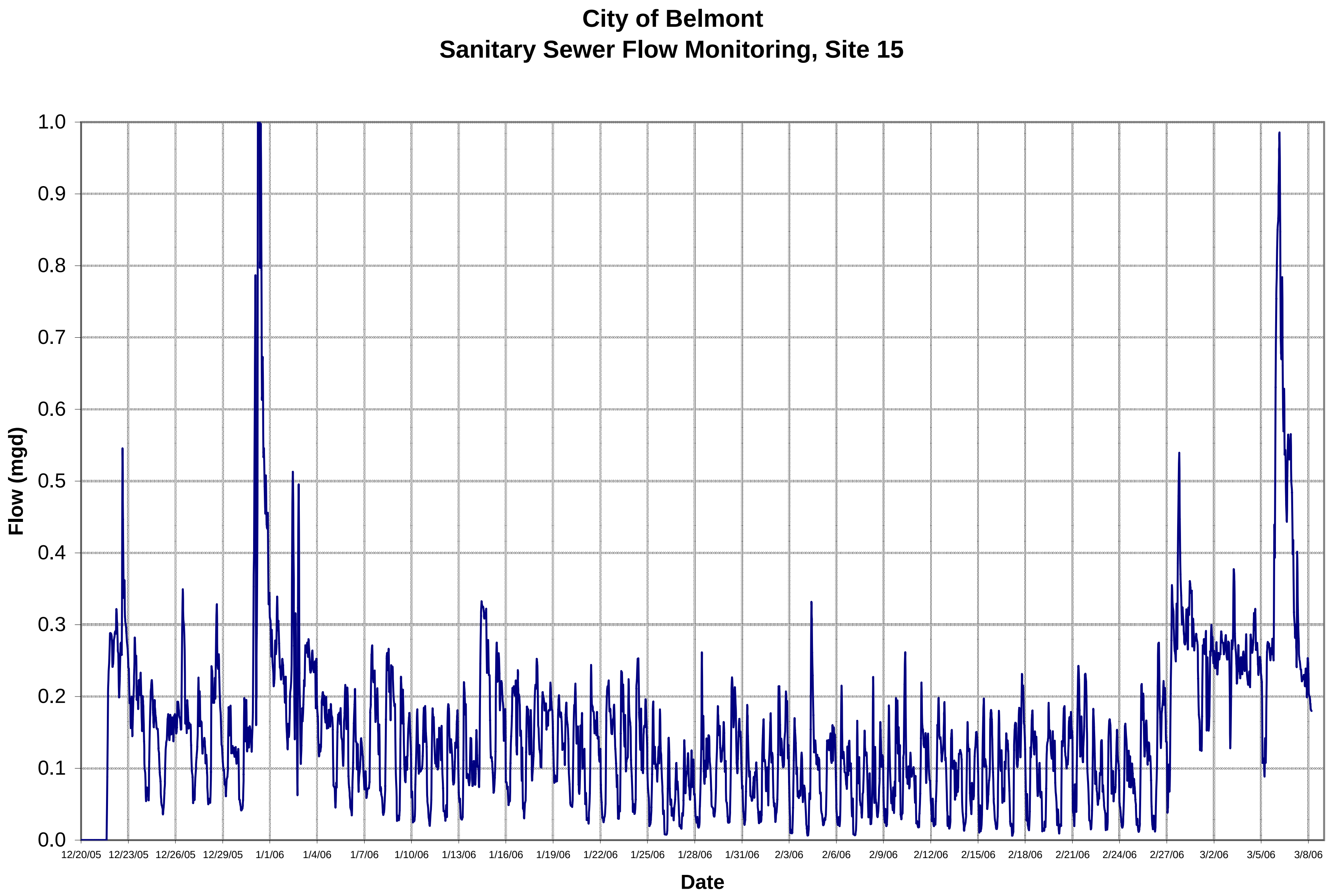


Site 13 hourly 010307.xls, Flow

City of Belmont
Sanitary Sewer Flow Monitoring,
Haskins Pump Station - Site 14

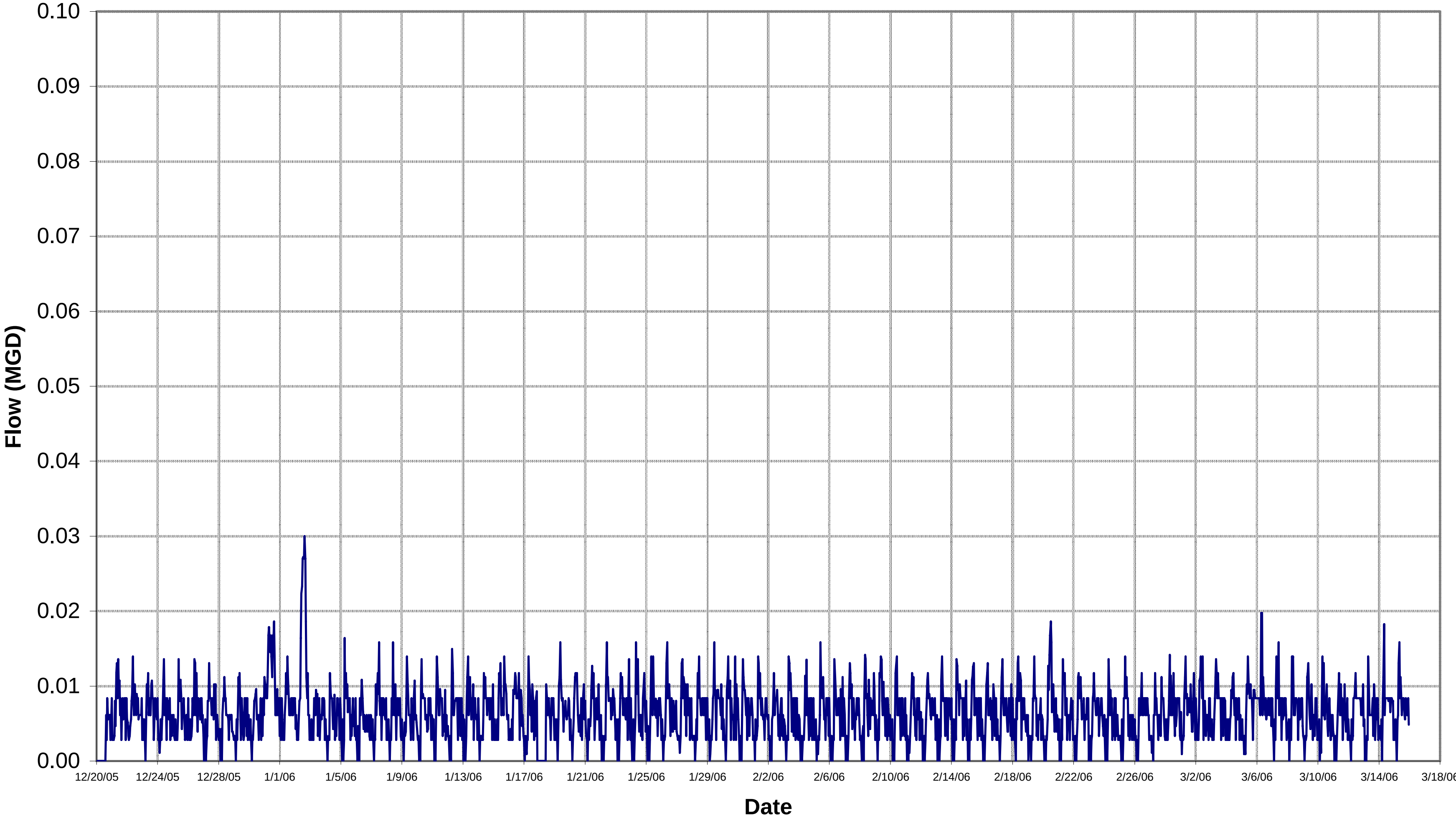


HASKINS Pump 031506.xls

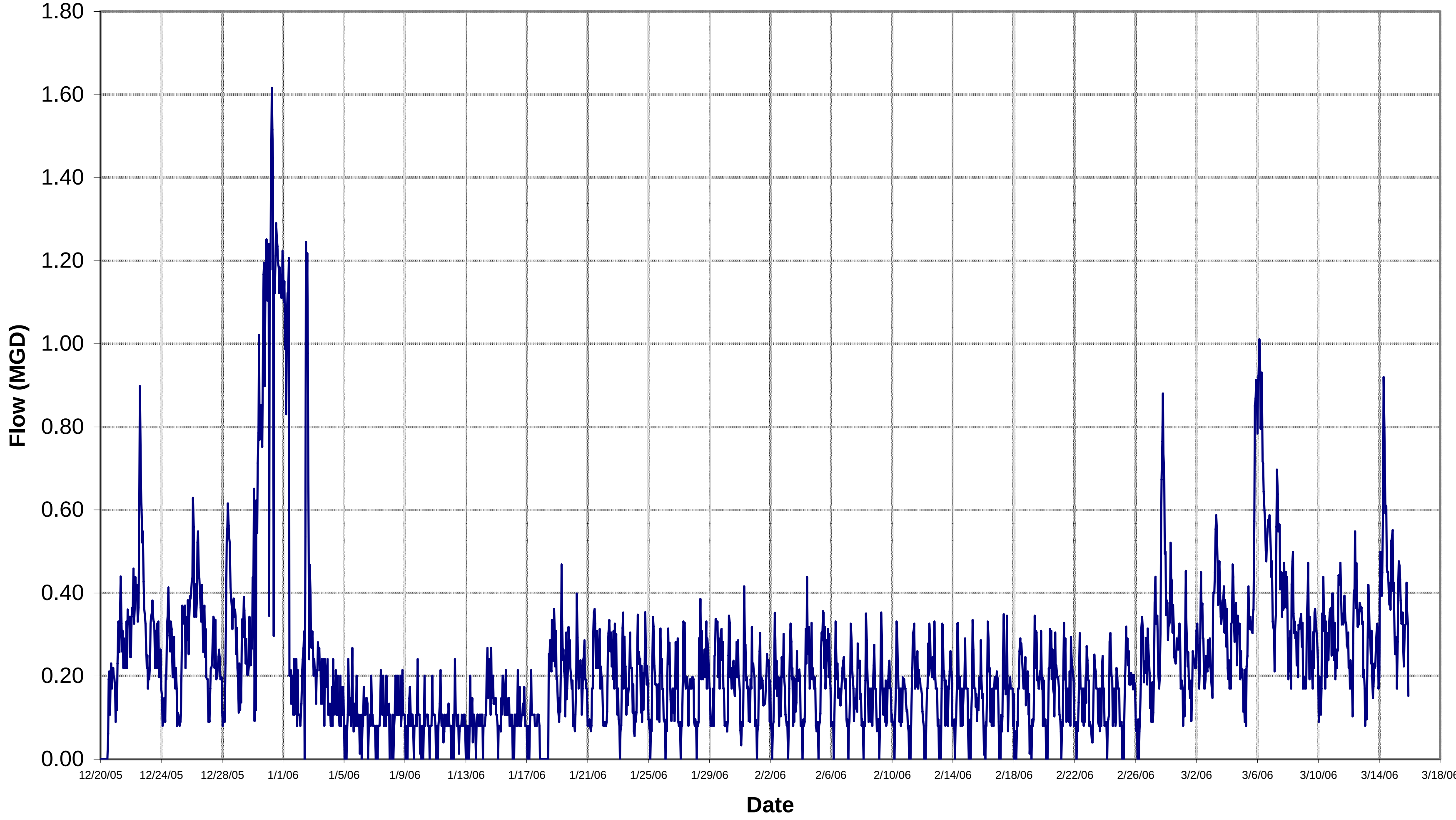


Site 15 hourly 010307.xls, Flow

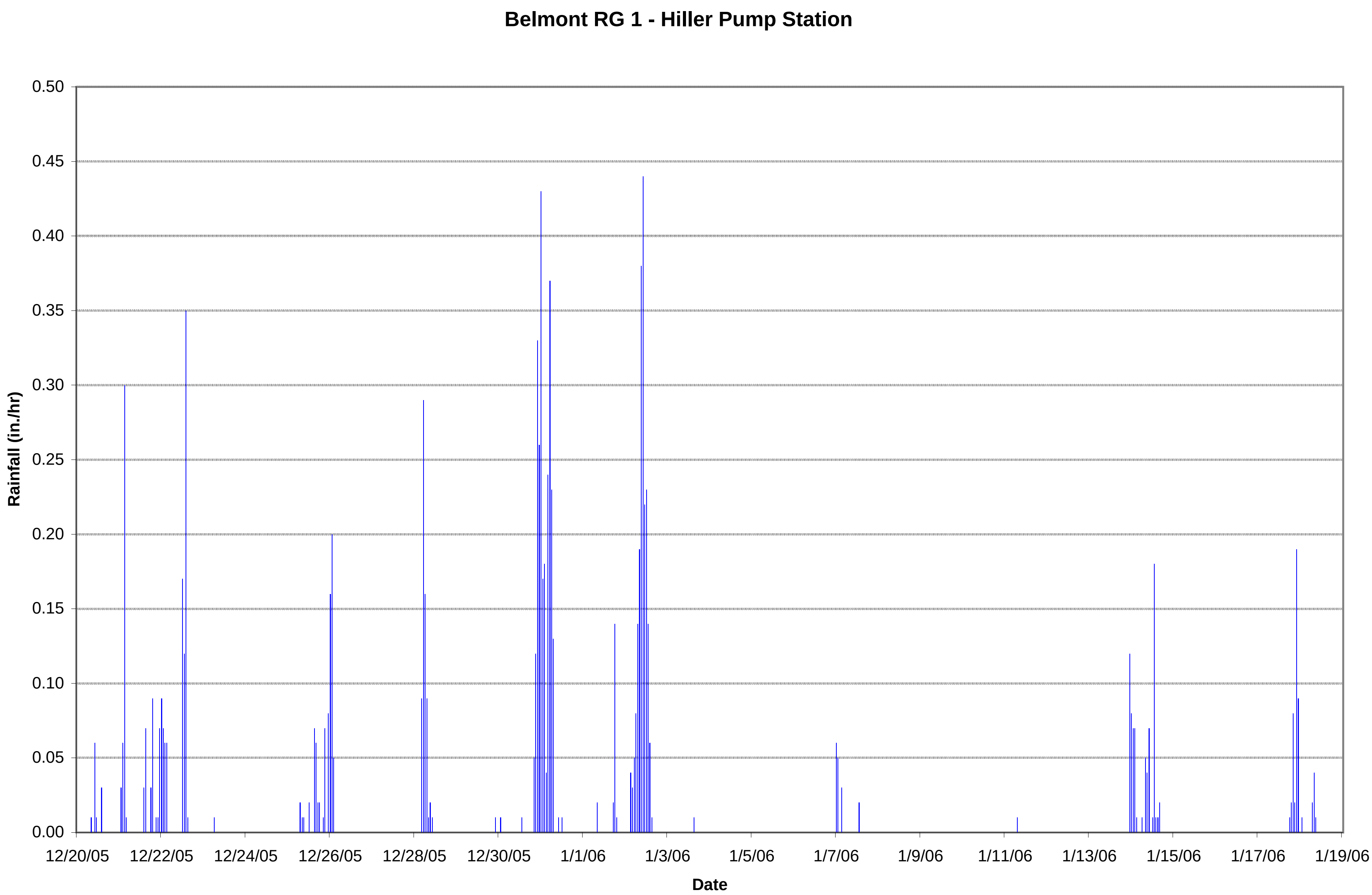
City of Belmont
Sanitary Sewer Flow Monitoring,
Island 2 Pump Station



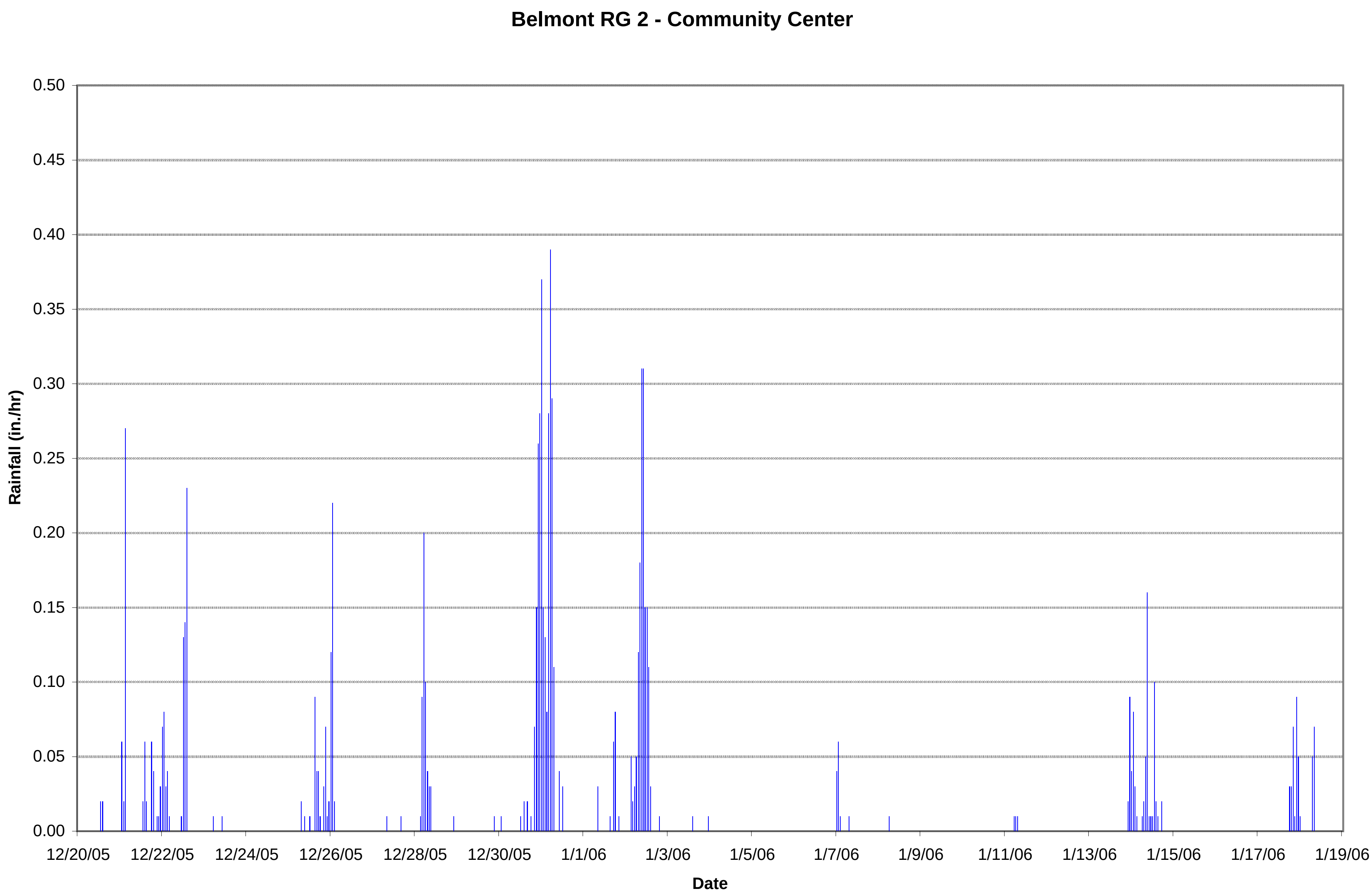
City of Belmont
Sanitary Sewer Flow Monitoring,
San Juan Pump Station



JAUN1 pump 012507.xls, Flow vs. Time

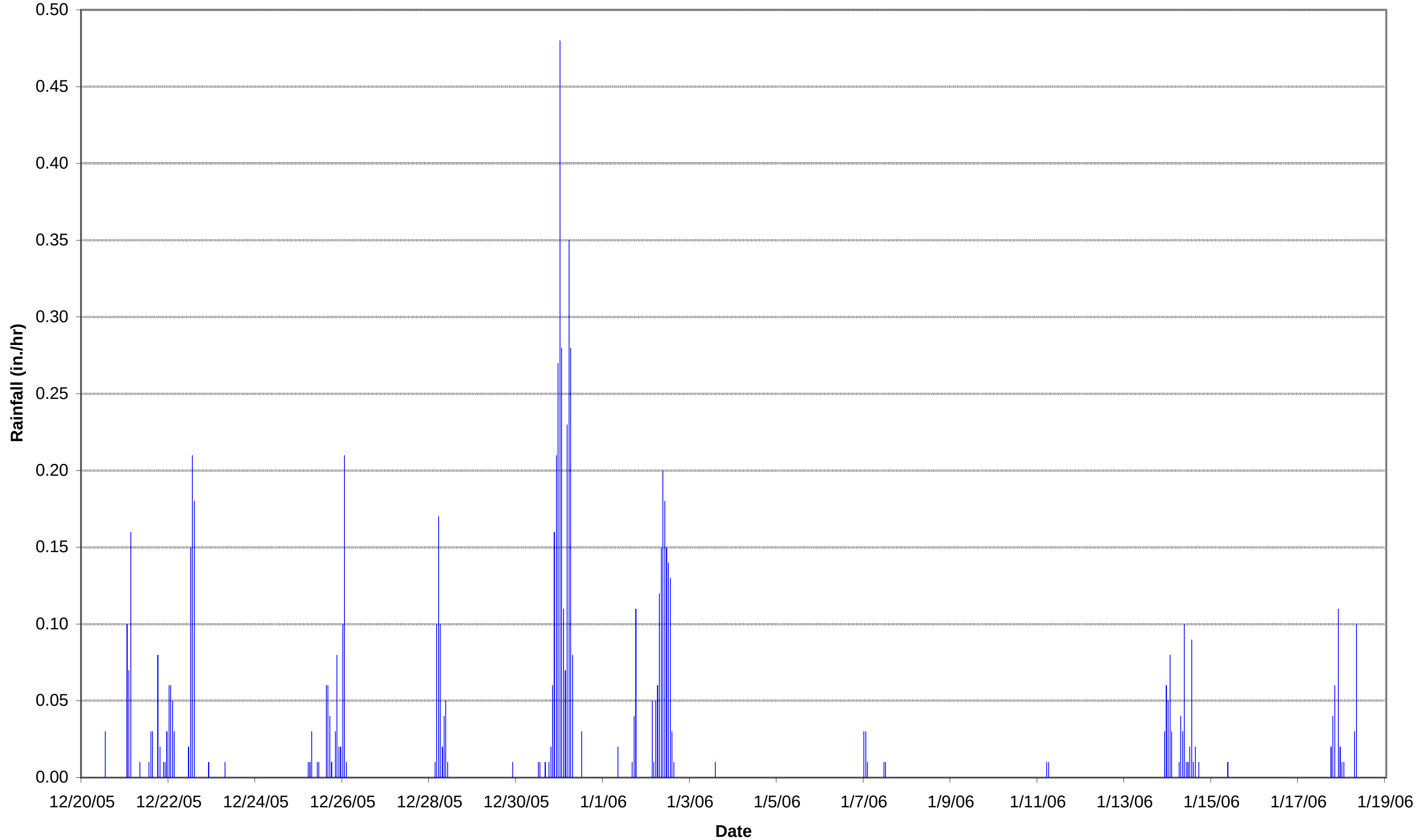


Belmont Rainplots 012306.xls, RG 1 Hiller



Belmont Rainplots 012306.xls, RG 2 Comm. Center

Belmont RG 3 - San Juan Pump Station



Appendix B - Estimation of Cost for Treatment of I/I TM

Technical Memorandum

City of Belmont – Sanitary Sewer Rehabilitation Plan

Subject:	**Estimation of Cost for Treatment of I/I**
Prepared For:	Bozhena Palatnik (City of Belmont)
Prepared by:	Carrie Teng (RMC), Cathy Greenman (RMC),
Reviewed by:	Gisa Ju (RMC)
Date:	July 12, 2007
Reference:	131-001

1 Introduction

This technical memorandum (TM) describes the results of the estimation of the cost that the City pays to the South Bayside System Authority (SBSA) for flow due to infiltration (I/I), conducted as part of the City of Belmont Sanitary Sewer Rehabilitation Plan (Project). As part of this analysis, RMC estimated the total annual volume of I/I generated in the City's sewer system, the percentage of I/I in relation to the total sewage flow, and the portion of the SBSA charge that could be attributed to I/I. This analysis is based on flow data provided by SBSA for the Shoreway Pump Station (referred to in SBSA flow records as the Belmont Pump Station) and copies of cost calculations and relevant agreements with SBSA provided by the City with respect to allocation of capital and operating costs for conveyance and treatment of Belmont flows.

Section 2 of this TM provides a brief overview of the City's relationship with SBSA. Section 3 discusses the flow data analysis, and Section 4 provides the calculation of the estimated cost for conveyance and treatment of I/I.

2 Background

The City is a member agency of SBSA. Wastewater is conveyed through the City's sewer system to the SBSA pump station located on Shoreway Road. SBSA pumps the City's wastewater flow from the Shoreway Pump Station to the SBSA treatment plant in Redwood Shores.

The City currently has capacity rights with SBSA for 11.8 MGD peak wet weather flow and 2.74 MGD dry weather flow. The City purchased additional wet weather flow rights in year 2000 to increase its previous capacity rights of 8.8 MGD peak wet weather flow. The City purchased additional dry weather flow rights in year 2001 to increase its prior dry weather capacity rights of 2.3 MGD.

SBSA bills each of its member agencies annually for estimated operational expenses, capital expenses, and reserves for the upcoming fiscal year. SBSA bases these contributions on estimated expenses allocated according to flows and loadings as determined by three-year average sampling.

3 Flow Data Analysis

Flow data from the SBSA Shoreway Pump Station in Belmont were analyzed to determine the average dry weather flow and the additional volume of flow that is attributed to I/I.

SBSA provided daily flow data for the Shoreway Pump Station during the period from November 2005 through October 2006 for this analysis. According to SBSA, there were several days during this period when flow data were not available due to one of the following reasons: 1) the telemetry system was out of service, preventing information from reaching the SCADA computer at the treatment plant, or 2) the inlet gate was closed and a portion of the wastewater was diverted into the San Carlos sewer system. Flow data for the missing days were estimated based on the trend of sewer flow, rainfall records, and flow diversion records provided.

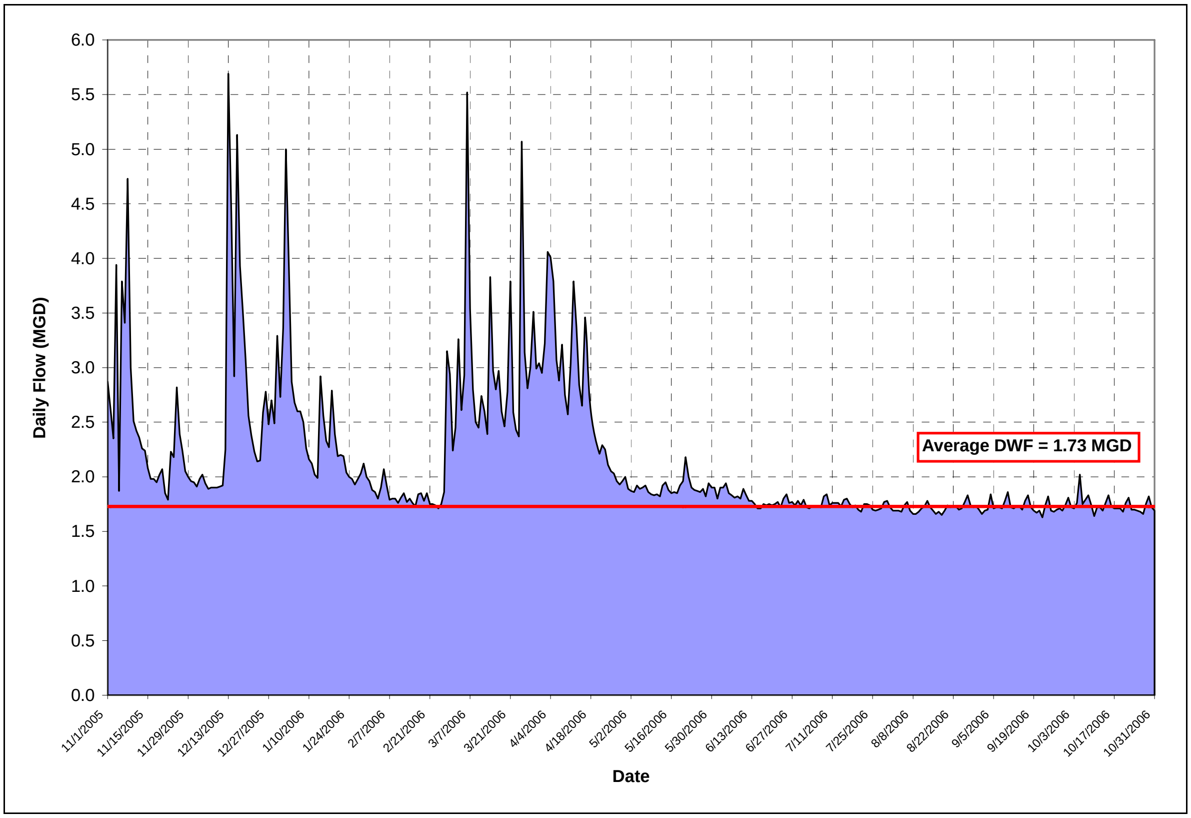
The average dry weather flow (DWF) was estimated using the data for the dry months of July, August, and September. The flow due to I/I was then estimated by subtracting the annual DWF from the total annual flow. **Figure 1** shows the flow data, highlighting the level of dry weather flow throughout the observed period compared to the total flow. As shown in the figure, the average DWF was determined to be approximately 1.73 MGD. **Table 1** summarizes the calculation of annual I/I. The total annual flow due to I/I in 2005/2006 was determined to be 156 MG, or approximately 20% of the total annual flow. The peak daily I/I in the 2005/06 season, based on the recorded data at the pump station, was about 4 MGD; however, the actual peak day I/I was likely higher if diversions to San Carlos are included. According to the rainfall data provided by the National Oceanic and Atmospheric Administration (NOAA), the rainfall during 2005-2006 season in the proximity of Belmont was approximately 15-20 percent higher than average. Therefore, the I/I volume is likely to be higher than that in a typical year.

Table 1 – Estimate of Annual I/I Volume from Belmont

Flow	Value (MG)
Total Annual Flow	787
Total Annual DWF[a]	631
Total Annual Flow due to I/I[b]	156

(a) 1.73 MGD Average DWF x 365 days
(b) Total Annual Flow – Total Annual DWF

Figure 1 – Belmont Pump Station Flow Data



4 I/I Cost Calculation

The cost of I/I treatment for the City for Fiscal Year 2006-2007 was estimated using the O&M budgets in the SBSA billing information, which is included in **Attachment 1** at the end of this TM. For each of the budget items, the total share for Belmont is calculated based on Flow, BOD, and Suspended Solids (S.S.) allocations to associated agencies and the Operations & Maintenance (O&M) budget breakdown. For Belmont, the portion related to flow was extracted from the total Belmont share and multiplied by the percentage of flow due to I/I (20 percent) to calculate the portion of O&M costs due to I/I. The total was then adjusted for interest income and miscellaneous items. The results of the calculation are presented in **Table 2**. As indicated in the table, the cost for conveyance and treatment of I/I is approximately $120,000 per year, or about 9 percent of Belmont's total share of SBSA O&M costs. The cost of I/I treatment for a typical year would be less than 9 percent as the average I/I volume is likely to be lower than that in the 2005-2006 season. It is important to note that the allocation to flow in the budgets is an accounting allocation, which does not necessarily correspond to the actual cost of O&M due to flow. Therefore, reducing I/I would not necessarily result in a proportional reduction in O&M costs.

Table 2 – I/I Charge Calculation

O&M Budgets	Flow	BOD	S.S.	Total	Belmont Total Share of O&M Costs[a]	Total Amount Allocated to Flow [b]	Amount Allocated to I/I [c]
Plant Support Service	100.0%	0.0%	0.0%	$2,148,877	$236,806	$236,806	$47,361
Plant Technical Service	26.5%	33.5%	40.0%	$1,086,505	$119,057	$31,729	$6,346
Plant Operations	26.5%	33.5%	40.0%	$5,716,783	$626,434	$166,947	$33,389
Plant Maintenance	26.5%	33.5%	40.0%	$2,455,245	$269,041	$71,701	$14,340
Pump Stations	Actual Costs			$840,402	$94,511	$94,511[d]	$18,902
Booster Station	n/a[e]			$42,704	$0	n/a	n/a
Force Main	100.0%	0.0%	0.0%	$39,575	$4,361	$4,361	$872
Source Control	Actual Costs			$508,763	$6,399	n/a[f]	n/a
O&M Expense Total				**$12,838,854**	**$1,356,609**	**$606,055**	**$121,210**
Less Interest Income	26.5%	33.5%	40.0%	$37,000	$4,054	$1,081	$216
Less Miscellaneous	26.5%	33.5%	40.0%	$245,000	$26,847	$7,155	$1,431
O&M Revenue Required				**$12,556,854**	**$1,325,708**	**$597,819**	**$119,563**

(a) The sum of Belmont share based on Flow, BOD, and S.S. allocations to agencies and O&M budget breakdown
(b) Belmont share related to Flow only
(c) Belmont Flow Share x Percentage of Flow due to I/I (20%)
(d) The entire cost of Belmont Pump Station is assumed to be allocated to Flow
(e) Booster Stations budgets are not allocated to Belmont
(f) Source control budgets are assumed not to be related to flow

Attachments

1 – SBSA Billing Information for FY 2006-2007

Attachment 1 – SBSA Billing Information for FY 2006-2007

FOR WATER QUALITY

SOUTH BAYSIDE SYSTEM AUTHORITY

JOINT POWERS AUTHORITY — A Public Entity

1400 Radio Road • Redwood City, California 94065-1220 • 650/591-7121

FAX 650/591-7122

City of Belmont

City of Redwood City

City of San Carlos

West Bay Sanitary District

REVISED June 26, 2006

32-20

8/8

Mr. Thomas Fil
Finance Director
City of Belmont
One Twin Pines Lane
Belmont, CA 94002

Ref: Billing for Operations, Capital and Reserves

Dear Mr. Fil:

Please see the attached allocation which outlines each member agency's contribution to the South Bayside System Authority's operational expenses, capital expenses and reserves for fiscal year 2006-2007. Contributions are based on estimated expenses allocated according to flows and loadings determined by three year average sampling. At the completion of the fiscal year actual expenses will be allocated according to these flows and loadings in accordance with provisions of the Joint Powers Agreement.

City of Belmont's contribution for operations should be made in twelve monthly installments of $110,475.67. City of Belmont's contribution for capital should be made in twelve monthly installments of $2,366.75. The total monthly contribution is $112,842.42. **Contributions should be received prior to the first of the month for which they are due.** The July contribution is due before July 1st. Payments should be made payable to SBSA Controller, P. O. Box 391, Redwood City, CA 94064.

Contributions for reserves should be made in two installments of $234,393.00 due December 15, 2006 and April 15, 2007.

Please contact me at (650) 594-8411, Ext. 126 if you have any questions relating to the attached allocation.

Very truly yours,

Linda M. Bruemmer

Linda M. Bruemmer
Support Services Manager

LMB/dlk
Attachment

ALLOCATION TO AGENCIES - Fiscal Year 2006-2007

	Flow (Q)	BOD (B)	S.S. (S)	Total	Belmont	Redwood City	San Carlos	W.B.S.D.	SM County	Totals
FLOW (Q)				100.00%	11.02%	47.72%	15.40%	25.86%		100.00%
BOD (B)				100.00%	10.50%	45.80%	13.00%	30.70%		100.00%
S.S. (S)				100.00%	11.30%	46.00%	14.30%	28.40%		100.00%
& M BUDGETS										
lant Support Sen	100.0%	0.0%	0.0%	$2,148,877	$236,806	$1,025,444	$330,927	$555,700		$2,148,877
lant Technical Se	26.5%	33.5%	40.0%	$1,086,505	$119,057	$504,017	$153,806	$309,626		$1,086,505
lant Operations	26.5%	33.5%	40.0%	$5,716,783	$626,434	$2,651,947	$809,268	$1,629,135		$5,716,783
lant Maintenance	26.5%	33.5%	40.0%	$2,455,245	$269,041	$1,138,959	$347,564	$699,681		$2,455,245
ump Stations	Actual Costs			$840,402	$94,511	$453,632	$137,924	$154,335		$840,402
ooster Station	92% WBSD / 8% RC			$42,704	$0	$3,416	$0	$39,288		$42,704
orce Main	100.0%	0.0%	0.0%	$39,575	$4,361	$18,885	$6,095	$10,234		$39,575
ource Control	Actual Costs			$508,763	$6,399	$184,421	$138,083	$147,643	$32,217	$508,763
O&M Expense Total				$12,838,854	$1,356,609	$5,980,721	$1,923,667	$3,545,641	$32,217	$12,838,854
ess Interest Incor	26.5%	33.5%	40.0%	$37,000	$4,054	$17,164	$5,238	$10,544		$37,000
ess Miscellaneou	26.5%	33.5%	40.0%	$245,000	$26,847	$113,653	$34,682	$69,819		$245,000
O&M Revenue Required				$12,556,854	$1,325,708	$5,849,905	$1,883,747	$3,465,278	$32,217	$12,556,854
APITAL IMPROVEMENT FUND										
ant	Equity @ 6/30/96			$318,750	$28,401	$149,303	$42,904	$98,143		$318,750
ump Stations	Agency Served			$0	$0	$0	$0	$0		$0
ooster Station	100% WBSD			$0	$0	$0	$0	$0		$0
Subtotal				$318,750	$28,401	$149,303	$42,904	$98,143	$0	$318,750
ss Interest Income	Equity @ 6/30/96			$0	$0	$0	$0	$0		$0
CIP Revenue Required				$318,750	$28,401	$149,303	$42,904	$98,143	$0	$318,750
ESERVE CONTRIBUTIONS										
ant Replacemen	39.0%	36.0%	25.0%	$4,257,969	$464,238	$1,984,162	$607,229	$1,202,340		$4,257,969
ump Station Replace	100% Agency Served			$0	$0	$0	$0	$0		$0
ooster Replacement	92% WBSD / 8% RC			$0	$0	$0	$0	$0		$0
&M Reserve	% O & M			$0	$0	$0	$0	$0		$0
sk Management	100.0%	0.0%	0.0%	$0	$0	$0	$0	$0		$0
ng-life Replacer	39.0%	36.0%	25.0%	$0	$0	$0	$0	$0		$0
Reserve Total				$4,257,969	$464,238	$1,984,162	$607,229	$1,202,340	$0	$4,257,969
EVENU Member Contributions				$17,133,573	$1,818,346	$7,983,369	$2,533,879	$4,765,761	$32,217	17,133,573
&M excess to Re	39.0%	36.0%	25.0%	$114,980	$47,240		$67,740			$114,980
ldl payment to R	39.0%	36.0%	25.0%	$360,020	$4,548	$221,344		$134,128		$360,020
Total Supplment to Replacement				$475,000	$51,788	$221,344	$67,740	$134,128	$0	$475,000

TARGETED O&M RESERVE - Fiscal Year 2006-2007

	Total	Belmont	Redwood City	San Carlos	W.B.S.D.	SM County	Totals
General Reserve @ 6/30/05 (from Analysis of Net Assets)	$371,075	$70,425	($394,632)	$597,570	$97,712		$371,075
	100.00%	18.98%	-106.35%	161.04%	26.33%	0.00%	100.00%
Net Working Capital @ 6/30/05	$767,812	$145,720	($816,555)	$1,236,465	$202,181	$0	$767,812
Target Reserve as 26.5% 33.5% 40.0%	$898,720	$98,480	$416,905	$127,223	$256,112	$0	$898,720
Res 02-49 dated 7.00%							
Over / (Under)	($130,908)	$47,240	($1,233,460)	$1,109,243	($53,930)	$0	($130,908)
Supplement to Re 39.0% 36.0% 25.0%	$475,000	$51,788	$221,344	$67,740	$134,128		$475,000
O&M Excess to Replacement Reserve	$114,980	$47,240		$67,740			$114,980
Additional Payment to Replacement Reserve	$360,020	$4,548	$221,344		$134,128		$360,020
Additional Payment for amount under-reserved	$1,287,391		$1,233,460		$53,930		$1,287,391
Total Additional Payment Required	$1,647,411	$4,548	$1,454,805	$0	$188,058		$1,647,411
MEMBER AGENCY PAYMENT SUMMARY							
Regular Member Contributions for O&M Expense (monthly installments)	$12,556,854	$1,325,708	$5,849,905	$1,883,747	$3,465,278	$32,217	$12,556,854
Regular Member Contributions for Capital Improvement (due in August)	$318,750	$28,401	$149,303	$42,904	$98,143		$318,750
Regular Member Contributions for Replacement (due in August)	$4,257,969	$464,238	$1,984,162	$607,229	$1,202,340		$4,257,969
Subtotal Regular Member Agency Payments	$17,133,573	$1,818,346	$7,983,369	$2,533,879	$4,765,761	$32,217	$17,133,573
Additional Member Contributions for Replacement Reserve (due in August)	$360,020	$4,548	$221,344		$134,128		$360,020
Additional Member Contributions for O&M under-reserved (Dec & April)	$1,287,391		$1,233,460		$53,930		$1,287,391
Total Member Agency Payments	$18,780,984	$1,822,894	$9,438,174	$2,533,879	$4,953,819	$32,217	$18,780,984